THE RELATIONSHIP OF INSTRUCTIONAL DELIVERY METHODS AND INDIVIDUAL DIFFERENCES TO THE TRAINING OF OPERATORS OF COMPUTER SYSTEMS

by

E. Alan Kluge

A THESIS

Submitted to

Oregon State University

In Partial Fulfillment

of the Requirements for the Degree

Doctor of Philosophy

Completed May 2, 1988

Commencement June 1988

AN ABSTRACT OF THE THESIS OF

E. Alan Kluge for the degree of Doctor of Philosophy

in Education presented on May 2, 1988.

Title: The Relationship of Instructional Delivery Methods and Individual Differences to the Training of Operators of Computer Systems

Abstract approved: *Redacted for Privacy*

Dr. Tom E. Grigsby

The objectives of this study were to: (1) determine if individual differences in the learner characteristics of field dependence, state and trait anxiety, age, sex, and prior computer experience were related to performance in operating a computer system; (2) to determine if differences in performance would occur as a result of two different instructional delivery methods, manual-based training (MBT) and instructor-based training (IBT); and (3) to determine if differences in performance between instructional delivery methods could be partially explained by differences in the learner characteristics examined.

An experimental research design was used involving two groups of subjects. The control group was trained to operate a computer software system using MBT, the experimental group was trained to operate the same system using IBT. Subjects were administered two standardized instruments, the Group-Embedded Figures Test and the State-Trait Anxiety Inventory. A demographic questionnaire was used to identify age, sex, and prior computer experience. Participants in the study

were 72 undergraduate students enrolled in one or more courses in Hotel, Restaurant and Tourism Management at Oregon State University in April of 1987.

Chi-square, t-tests, analysis of variance, regression analysis, and Pearson product-moment correlations were used to test the hypotheses of this study. The following findings were considered significant at the .05 level of confidence:

1. There was a negative correlation between execution time in performing tasks on the computer and level of field dependence. Subjects who were more field independent (higher GEFT score) took less time to perform a series of tasks following training.

2. There was a difference in training time between MBT and IBT. Subjects trained using IBT took significantly longer to train than did subjects using MBT.

3. There was a difference in execution time between MBT and IBT. Subjects trained using MBT took significantly longer to complete the representative tasks than did subjects using IBT.

4. There was a negative correlation between field dependence and execution time for MBT, but not for IBT.

Based on the results of this study there appears to be evidence that individual differences and training delivery methods effect performance in operating a computer software system. Further research is recommended to better define the relationship of these variables to performance.

APPROVED:

Redacted for Privacy

Associate Professor of Post-Secondary Education in charge of major

Redacted for Privacy

Head of department of Post-Secondary Education

Redacted for Privacy

Dean of School of Education

Redacted for Privacy

Dean of Graduate School

Date thesis is presented May 2, 1988

Typed by E. Alan Kluge

DEDICATION

This study is dedicated to the memory of my mother, Eva Jean Kluge, an individual who dedicated her entire life to education. Through a career as a teacher which started in a one-room schoolhouse in Wyoming, and spanned nearly forty years, she was responsible for the education, and more importantly, the personal development of hundreds of children.

Above all else, I hope I am able to exhibit the same level of compassion and genuine concern for the lives of each of my students as my mother showed for hers.

ACKNOWLEDGEMENTS

It has been through the commitment of time and concern by many people that I was able to complete my doctoral program. I am grateful to the members of my committee who exhibited great caring and flexibility in responding to my needs. Forrest Gathercoal, Patricia Wells, and Michael Beachley all provided constant support and valuable assistance throughout my degree program. Barry Shane, a committee member, along with Jack Drexler and Bob Collins from the College of Business, offered constructive criticism and suggestions which greatly improved the quality of this research. I am most grateful for their contributions.

I will always be indebted to Tom Grigsby, my major professor. While I admire many things about this man, the one lesson he has taught which stands out most is a concern for the "process" of education, a concern which motivated this research. As an "educator of educators" Tom successfully teaches through his actions and behavior as much, if not more so, than through words. Always finding time for the student, encouraging original thought and investigation, and providing healthy criticism are the qualities he possesses. I look forward to the opportunity of continuing to work with Tom as a colleague.

Finally, I wish to acknowledge the constant support and sacrifice made by my wife Alice, and daughter Amy. I have missed much of the first two years of Amy's life, Alice having to often serve as both mother and father. I look forward to being able to take a much more active and supportive role in their lives.

Table of Contents

Page

Page

Page

Page

Page

Appendices

List of Figures

List of Tables

Page

THE RELATIONSHIP OF INSTRUCTIONAL DELIVERY METHODS AND INDIVIDUAL DIFFERENCES TO THE TRAINING OF OPERATORS OF COMPUTER SYSTEMS

CHAPTER 1

INTRODUCTION

> It is a common observation that there are great differences in people's ability to make use of conventional computing facilities. Early studies in programming, for example, found large discrepancies in performance, even at the professional level (Weinberg, 1971). In universities it has been observed that some individuals make more effective use of facilities than others who have undergone the same training and whose needs are just as great. Of those attending post-graduate courses, some individuals require little more than a manual and a user number, while others require careful explanation before they are able to complete even the simplest task. This discrepancy is particularly interesting in a university environment because it suggests that some factors other than general intelligence (motivation, prejudice, etc.) are operating.
>
> It is proposed that the study of such individual differences in learning of computing skills would provide valuable insights into ways of effectively supporting computer users. (Coombs, Gibson, Alty, 1981)

The above quotation, taken from Coombs and Alty's book Computing Skills and the User Interface (1981) identifies the background and need for understanding individual differences as they effect the training of individuals to operate computers.

In business and industry, twelve to fifteen million workers, one out of eight employed Americans, currently use a computer at work (Feuer, 1986). For the vast majority of these individuals, the computer is a tool they are required to utilize in getting their job done. Each year millions of people are being trained in the operation of computer systems, and yet little scientific research has been conducted to investigate such training and the variables which impact upon its effectiveness.

In primary, secondary, and post-secondary education, computing is being adopted as a basic subject.

> The rise in status of the subject has produced a demand for instruction at a time when little is known either about the nature of computing skills, or about effective methods of teaching them. There is therefore an urgent need for a substantial research effort in this area. (Coombs & Alty, 1981)

While the literature related to training and computers is abundant with articles on successful programs for training computer users, such literature is predominantly experiential in nature. Limited work has been done in relating empirical findings to behavior and learning theory. To date the design of computer systems, and the training to support those systems, has been largely based on the experience and intuition of the system designer (Jagodzinski, 1983). It has only been during the past few years that scientific research has been conducted to begin to investigate variables that impact upon the training encounter of teaching individuals to operate computer systems (for examples see Coombs, Gibson, Alty, 1981; Carroll & Carrithers, 1984; Carroll & Mack, 1984; Deck & Sebrechts, 1984).

Many basic questions related to effectively training computer operators remain unanswered. As the use of computers continues to expand, and the range of computer users continues to broaden, the importance of research in this area increases. Research in this field has the potential of impacting millions of individuals in business, at school and at home.

Background of the Problem

This study continued the research begun by Coombs, Gibson and Alty (1981), investigating individual differences in the acquisition of computer skills. It was also intended to expand the scope of the problem beyond a single training method.

In designing their research, Coombs et al. identified two tasks for their subjects to complete, the "target" task and the "indicator" task. Performance on the target task is the unknown. Performance on the indicator task, expected to have some identifiable relationship to the target task, is used to generate hypotheses about strategy and performance on the target task.

As their indicator task, Coombs et al. investigated Pask's (1976) classification of cognitive style (described as Operation Learner versus Comprehension Learner) measured using the Spy-ring History Test. Their target task was performance in diagnosing a computer program, correcting errors within individual program statements and correcting the sequence of program statements as the result of skills learned in a computer programming course. While their findings were mixed, they did find scientific support for learning style being significantly correlated to performance on the target tasks. From their study they were able to conclude:

1. It is possible to define at least two different learning styles in a population of novice computer users.

2. Students exercising one of the styles - Operations Learning - are more successful at assembling language structures into an effective algorithm.

3. The successful learning style is defined by close attention to detail and a preference for procedural representation.

4. Success in the correct identification of individual language structures is independent of learning style.

Coombs et al.'s study provides evidence that performance in computer programming is related to cognitive style. However, it fails to consider the nature of the training received as an intervening variable which would account for such a relation.

This study expanded on the indicator tasks and target tasks used by Coombs et al. Indicator tasks utilized were completion of tests for field dependence and independence - a measure of cognitive style, tests to measure levels of state and trait anxiety, along with measures of prior computer experience, sex, and age. Target tasks included measures of performance in using a commercial type computer software system (instead of computer programming) following two different modes of instructional delivery. The results are intended to determine if the indicator tasks of this study serve as better predictors of target task strategy and performance, and also to determine if indicator tasks relate to the mode of instruction received.

Purpose of the Study

The purpose of this study was to measure and compare the effectiveness of two instructional delivery methods, instructor-based training (IBT) and manual-based training (MBT), in educating individuals to operate a computer software system.

The study assessed the overall effectiveness of each of the two instructional methods. The study also analyzed the effectiveness of each delivery method as it correlates to the characteristics of the individual learner. Specific learner attributes investigated were cognitive style, state and trait anxiety, prior computer experience, age, and sex.

Objectives

The specific objectives of this study were:

1. To determine if individual differences in the learner characteristics of field dependence, state and trait anxiety, age, sex, and prior computer experience were related to performance in operating a computer software system.
2. To determine if differences in performance would occur as a result of two different instructional delivery methods, manual-based training and instructor-based training.
3. To determine if differences in performance between instructional delivery methods could be partially explained by differences in the learner characteristics examined.

Significance of the Study

Educators, trainers, and individuals seeking assistance in developing training for computer operators will find agreement in the literature about the major training methods available. Specific training methods most often cited are manual-based instruction, tutorial software, video tape, instructor led in-house training, instructor led training using external consultants, customized external training, and general audience seminars (Callagan, 1985; Kazlauskas & McCrady, 1985). However, these articles only discuss the strengths and weaknesses of each delivery method, and stop short of assisting the training provider in selecting the most appropriate method given a specific training setting. Such a shortfall can be attributed to the lack of any theoretical foundation on which prediction of success in a new setting can be made.

In order to advance knowledge in this area beyond its current experiential base, it is necessary that we begin to identify and test underlying theories that will help to explain different effectiveness levels of specific instructional delivery methods in given settings. This study was designed to investigate the relationship of individual differences in people receiving computer training with the effectiveness of two common instructional delivery methods.

Limitations and Delimitations of Study

Subjects in this study were 72 undergraduate students enrolled in the Hotel, Restaurant and Tourism Management Program at Oregon State University. The relatively small number of subjects used in the study and the specialized nature of their academic preparation may limit the ability to generalize the findings of this study to other groups of college students, or to other populations.

Research design decisions limiting the scope of this study were: (1) examination of only two instructional delivery methods, manual-based training and instructor-based training, (2) limiting the test population of subjects to college students, and (3) having the principle investigator serve as the instructor in administering the instructor-based training treatment.

Definition of Terms

In order to attain precision and clarity of meaning, the terms frequently used in this research are defined as follows:

Anxiety: A specific unpleasant emotional state or condition of the human organism that includes experiential, physiological, and behavioral components (Freud, 1936). Characterized by subjective feelings of tension, apprehension, nervousness, worry, and by activation or arousal of the autonomic nervous system (Spielberger, 1983).

Cognitive Styles: The characteristic, self-consistent modes of functioning which individuals show in their perceptual and intellectual activities (Witkin et al, 1971). The learner's typical modes of perceiving, thinking, remembering, and problem solving (ERIC, 1987).

Experiential: Derived from experience and intuition without regard for science and theory (Webster, 1985).

Field Dependent: A term used to describe a subject who relies on external cues rather than his internal proprioceptive sense receptors in judging his relationship to the environment (Lovell, 1980). The designations field-dependent and field-independent reflect tendencies, in varying degrees of strength, to rely on self or field. They do not represent two distinct types of human beings (Witkin, 1977).

Field Independent: A term used to describe a subject who relies exclusively on his own internal sensory process in judging his relationship to the environment (Lovell, 1980).

Individual Differences: Differences in personality, attitudes, physiology, learning or perceptual processes, that account for variations in performance or behavior (ERIC, 1987).

State Anxiety: Intensity of emotional reaction to perceive a specific situation or period of time as being stressful or dangerous (Spielberger, 1983).

Training Methods: Standard procedures or approaches designed to help individuals or groups acquire the skills needed for specific activities or functions (ERIC, 1987).

Training: Instructional process aimed at the acquisition of defined skills relating to particular functions or activities (ERIC, 1987).

Trait Anxiety: Relatively stable predisposition to anxiety-proneness, the tendency to perceive stressful situations as dangerous or threatening (Spielberger, 1983).

CHAPTER 2

LITERATURE REVIEW

> Much more research needs to be focused on the personal and situational factors which moderate the effectiveness of alternative training methods. (Carroll et al., 1972)

The review of the literature is presented in six major sections. The first section presents major trends which have motivated research in this field. The second section presents the theoretical foundations underlying the research. The next two sections review prior research and publications related to computer training and instructional delivery methods. The fifth section presents a review of the literature related to each of the individual characteristics examined in this study. The final section reviews methodological issues relevant to conducting computer research.

Trends Motivating Research

Three major trends during the past two decades have motivated researchers to investigate the personal and situational factors surrounding users of computers. These three trends have been: (1) an expanding range of computer users, (2) changes in the nature of computer systems, and (3) the need to continually upgrade computer skills.

Expanding Range of Computer Users

As early as 1969, Nickerson noted that the community of computer users was becoming increasingly heterogeneous. A population of users that had been a select group of individuals sharing a common interest in computer technology per se, had changed to include scientists, managers, educators, students, and administrators.

Computer usage today is tending to become a part of the daily routine of many individuals, not computer professionals, but individuals who are interested in utilizing the computer as a tool to facilitate their work and activities (Paxton & Turner, 1984). More and more people inexperienced with computers are being required to interact with them in their work. The proportion of inexperienced users required to use computers on a daily basis is increasing (Allwood, 1986).

Changing Nature of Computer Systems

Problems have arisen because computer use has, over time, become much easier. As computing resources become more accessible, their use becomes feasible for a large population of non-specialists with little technical knowledge (Auld et al., 1981). Training of computer users was once limited predominantly to programmers, individuals willing to work hard and long at learning to operate the computer system. A 1985 Purdue survey of supervisors in 387 manufacturing firms indicated that supervisors no longer write programs, but instead use commercial software and software packages uniquely developed for their companies. Such packages are "user-friendly" and interactive, guiding the supervisor through the program step-by-step. The user does not need to learn a complex programming language, but rather the production requirements and tasks the computer supports (Bryan, 1986). Unlike the original system programmer, today's typical user has little technical computer knowledge, and is unwilling to undergo extensive training prior to using the computer (James, 1981).

Continual Upgrading of Computer Capabilities

As new, improved hardware and software continues to be released, so does the need for training. "Continually learning new systems is a way of life" (Hall, 1985). Much of the literature cited in this chapter is concerned with training the novice or inexperienced computer user. As the next generation finishes school, a generation that has grown up with computers, the need for such novice training should diminish. However, the proliferation of computers and their uses, combined with the constant development of new and improved systems, is projected to require more training than that offset by no longer having to train novice users.

As the number of users increases, and the applications become more varied, it becomes more and more difficult to meet the training needs of all the various groups of learners. It becomes even more difficult when attempting to plan for future needs (Auld et al, 1981).

Theoretical Foundations for Research

While the literature related to computers and to training and development is rich with articles on successful programs for training computer users, such literature is predominantly experiential in nature. To date, the design of computer systems, and the training to support those systems, has been largely based on the experience and intuition of the system designer (Jagodzinski, 1983). Mumford (1980) cautions against such an approach in discussing the effect of sociology on the design of information systems:

> Many articles on the design of computer systems start with a check list of steps or procedures which are put forward as a guide to eventual success. Other, more sophisticated writings, talk about taxonomy and categorize different aspects of the problem. . . .Few, however, go deeper than this and try to identify the intellectual theories that underpin the recipes that are recommended. . . .yet, every method or form of classification is based on a theory of some kind and it can be argued that faster progress would be made in developing useful methods and taxonomies if these underlying theories were made explicit and their validity examined and discussed. If theory is not made explicit then the assumptions behind current practice remain hidden and may not be recognized as false. Also practice becomes based on empiricism, on what seems to work rather than on understanding and knowledge of why it works.

Moran (1981) cautions that the enormous number of design guidelines developed without a theoretical basis may be contradictory, and that such a collection of procedures and guidelines motivated by design choices do not add up to a coherent psychological picture.

Green (1980) in his paper "Programming as a cognitive activity" points to three ways in which theory can help the investigator. First, a major role of theory in computer system design and training can be to test the truth of designer intuitions. When problems have two or more contradictory solutions, theories and experiments can be used to help in the choice of the best solution. Secondly, theory can be used to indicate by how much and under what conditions one method is better than another. As it relates to this study, the ability to indicate under what conditions one instructional delivery method is better than another is a major desired outcome. Thirdly, theory can suggest ways of doing things which may not be intuitively obvious, thereby opening up the range of possible solutions for both the researcher and practitioner.

This study attempted to identify and incorporate underlying theories in its design, both to serve as a guide in selecting among possible solutions, and as a tool in identifying all relevant variables and concerns which should be included in the research design.

Human Factors Research

This study followed a human factors approach to research. Human factors (or ergonomics) is often defined as the scientific study of the relationship between humans and their work environment (Murrell, 1965; Chapanis, 1965). The scope of human factors in the study of computer-based systems is concern for the relationship between man and machine, between the design of the machine and human performance (Parsons, 1970). The goal of human factors research is to discover the best combination of machine and human operations, a combination which is acceptable and satisfying to the user (Fitter et al, 1985). Unlike classic psychological research where the object of study has most often been the impact of the computer upon characteristics of the user (the user's motivation, attitudes, needs), human factors research focuses on human performance and the variables which impact upon that performance. Human factors research is most concerned with improving the efficiency and effectiveness of the man-machine system.

Human factors research related to computers has, for the most part, taken place within the past twenty years. Nickerson in 1969, after conducting a through review of the major journals in human factors and applied psychology, concluded that "there is remarkably little evidence of research that has been undertaken for the expressed purpose either of increasing our understanding of man-computer interaction or of providing information that will be useful in the development of systems that are optimally suited to users' needs and preferences" (p. 165). The one exception noted was a special March 1967 issue (Taylor) of the <u>IEEE Transactions on Human Factors in Electronics</u>, the first organized attempt to focus human factors research in the area of man-computer interaction. It was not until 1970 (Parsons) that the first significant attempt was made to identify the scope of human factors research related to computer-based systems.

The primary methodology of human factors research is to create knowledge through experiment and survey (Shneiderman, 1979; Parsons, 1970). The output of such research is reports and recommendations intended to influence system developers and operators. While ad hoc design processes based on intuition and limited experience may have been adequate for early programming languages and applications, such methodologies are inadequate for designing more contemporary systems which will be used by millions of diverse people (Shneiderman, 1979). As more people, and more diverse groups of people continue to use computers, computer-based products are going to require increasing levels of design effort and testing. Conflicting designs need to be evaluated through controlled experimental conditions. Not only should the results of such experimental research generate important information, but also the process of developing experiments should provide many worthwhile insights.

Human factors researchers are interested in a broad range of topics related to man-machine interaction. As identified by Parsons (1970), the four major areas of human factors research related to man-computer interaction are:

1. The design of machines and the resulting effect on human performance.

2. Development of procedures for operating and maintaining machines, including the development of "performance aids" to help the user in the course of his work.

3. Preparation of man, through training, to use the machine.

4. Determination of personnel requirements--skills, number, organization, assessment--for the man-machine system.

Table 2.1. identifies major groups of professionals involved in studying human factors issues related to the use of computers and their areas of concern.

Table 2.1. Professionals investigating human factors issues of computer use and their areas of research

Software designers
- menu selection techniques
- command, parametric, and query languages
- use of graphics, animation, and color
- direct manipulation
- natural language facilities
- error handling, messages, prevention
- screen formatting
Hardware developers
- keyboard design
- large, high resolution displays
- rapid response time
- fast display rates
- novel pointing devices
- speech input and output
Education psychologists and instructional designers
- online tutorials
- effective training and reference manuals
- online manuals and assistance
- classroom and individual training methods
- lectures versus experiential training
Sociologists and managers
- organizational impact
- computer anxiety
- job redesign
- retraining
- work-at-home
- long-term societal changes

Adapted from Shneiderman (1987)

This study focused primarily on the training aspect of human factors research, and on identified topics of direct concern to instructional designers and sociologists involved in man-machine research.

Evaluating Human Performance

A major goal of this research was to identify an instructional delivery method which, for a specified user or user group, results in the highest level of performance. Achieving this goal required the measurement and analysis of performance in completing a task.

Many researchers and system designers seeking to measure "human" performance actually measure "system" performance (Bailey, 1982; Taylor, 1957). Taylor illustrates this problem by comparing the speed of travel between a boy on a bicycle and a boy on a pogo-stick. During repeated trials, the boy on the bicycle consistently was able to travel a further distance in a set amount of time. In this situation the measure of performance was a measure of "system" performance (the combined performance of the human and technology), not a measure of "human" performance (performance of the human alone). The boy on the pogo-stick actually may have been doing a better job of pogo-stick jumping than the bicycle-rider was doing bicycle-riding. To meaningfully assess human performance the researcher must, to the greatest extent possible, separate human performance from the other components of system performance (recognizing that there is typically interaction between these two variables).

Bailey (1982), a human performance engineer with Bell Telephone Laboratories, developed a model of human performance presented in Figure 2.1.

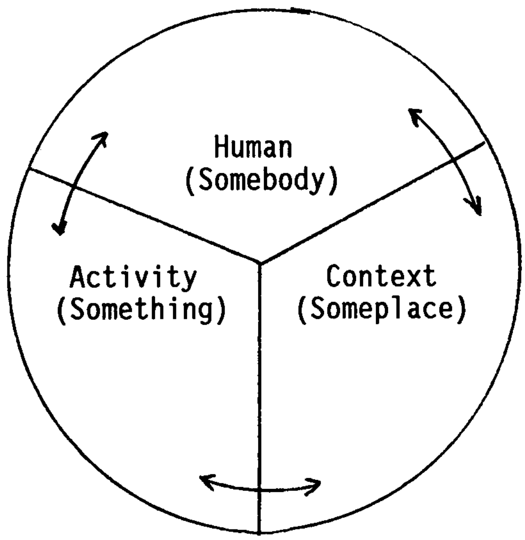

Figure 2.1 Human Performance Model (Bailey, 1982:18)

As illustrated by the model, evaluation and prediction of human performance requires an understanding of three major components: (1) the "human", the somebody involved in the performance, (2) the "activity" or the something being performed, and (3) the "context" or someplace in which the performance occurs. Occurrence of acceptable human performance depends on: (a) the adequacy of each major component, and (b) the adequacy of the interface between and among major components. Evaluation of human performance requires that all the elements, and their interactions, be taken into consideration.

The human. "Know the user" was the first principle in Hansen's (1971) list of user engineering principles. While this seems a simple and basic principle, it is generally an undervalued and difficult goal for system designers and trainers to achieve (Shneiderman, 1987). Traditionally the model used in developing systems and training is a model of a canonical (or typical) user (Rich, 1983). Individual users of a system vary so much, however, that a model of a canonical user is often insufficient, making models of individual users necessary.

All system and training design should begin with an understanding of the intended user (Shneiderman, 1987). Table 2.1 presents the human characteristics considered to have the most significant impact upon the effectiveness of training and performance.

Table 2.2 Human characteristics important to human performance.

Age	
Sensory Characteristics	- visual acuity - auditory acuity - color perception
Responder Characteristics	- body dimensions - strength - handedness
Cognitive Characteristics	- general intelligence - problem solving ability - decision making ability - perceptual skills
Motivational Characteristics	- cooperativeness initiative persistence
Training and Experience	- general education level - specialized training - specialized experience

Source: Bailey, 1982, p. 545.

As presented in Table 2.2, the major considerations of the human component of a system are the sensors, brain (cognitive) processing, and responders. Also of concern are motivational factors and prior experience. If one or more of the abilities associated with each of these elements is deficient in the individual user, then it becomes the role of the trainer to provide an efficient way for the user to learn them. This assumes, of course, that the user has the capability of learning the needed skills.

In addition to the human abilities identified above, Alluisi and Morgan (1976) have suggested that it is also necessary to consider both temporal influences (e.g., biological rhythms, sleep, fatigue) and organismic influences (e.g., illness, drug reactions) when evaluating human performance. Also of concern must be influences which impact upon the mental health of the individual user (e.g., depression, chronic high anxiety, performance-affecting phobias).

The activity. While the system designer and trainer do not usually have much control over the human component of the model, they exercise a great amount of influence over design of the activity to be performed. Through proper work analysis and design, specification of appropriate interface devices (controls, displays, the workplace), and development of effective performance aids, instructions, and training, the activity can be properly specified and supported so as to lead to better performance by the system user.

The major concern of this study was identifying an appropriate training element of the activity component, given the characteristics of the human component, which will result in the highest level of human performance.

The context. There are two major elements of the context in which a human performs a particular activity: the physical context and the social context. The physical context includes the physical conditions and distractions which can impact upon human performance such as noise, lighting, and temperature. Conditions in the social context that may affect human performance include the effects of other people, crowding, and isolation. System designers and trainers must take into consideration the context in which the performance is to occur and, to the extent possible, control the context so as to provide for the highest level of human performance.

Interactions among components. An understanding of each of the three components separately (human, activity, and context) is not sufficient to evaluate human performance. The interaction between elements must also be examined. For example, in developing group training activities for computer system users, interaction between the user and training (human and activity) must be carefully designed. For example, pacing, identifying the importance and relevance of system functions, and providing adequate opportunities for practice are all activity design concerns which interact with the older user. Interaction between the activity and the context can occur when, for example, noise from an adjoining room makes it difficult for the trainer to communicate with trainees. Similarly, a noisy room may have a different effect on a well-rested person than it has on a person in need of sleep (interaction between human and context).

By identifying and understanding each of the three elements of human performance, and their interactions, we can begin to develop a theoretical framework for evaluating and improving human performance on a system.

Classification of Computer Tasks and Applications

One of the difficulties in developing a unified body of knowledge related to man-computer interaction has been the problem of attempting to generalize findings to a very broad spectrum of situations and applications. With the ever increasing number of computer users, their broadening backgrounds and experience, the increasing number and types of computer applications, and the constantly changing nature of the technology, the problem only continues to grow in complexity. As a result, findings of research conducted in one arena are commonly found inappropriate or non-generalizable to another.

No commonly accepted classification schema has been offered to coordinate research efforts. Only by identifying and examining issues within relatively homogeneous classifications will we begin to develop and validate a body of knowledge in this field. A review of the literature provides several dimensions already defined which can be combined to begin to develop such a classification system.

Three dimensions of classification that occur in the literature are presented as candidate dimensions for a classification schema. Similar to Bailey's (1982) model, these dimensions focus on the user, the computer activity, and the setting in which the use occurs. Specifically, the three dimensions are: (1) major user groups - classification based upon the educational and vocational backgrounds of individuals involved, (2) general computer function - classification of the major data processing activity being performed by the computer, and (3) primary computer application - the setting in which the computer use occurs. Four categories will be presented for each of the three dimensions, resulting in a 4 x 4 x 4 matrix, or a 64 cell classification schema for categorizing computer tasks and applications.

Major user groups. Mayer (1967), in assessing training requirements of computer users, identified four major groups of users performing computer tasks. She established the four task groups based upon educational and vocational levels. Parsons (1970) established a similar schema. By integrating their two classifications the following categories can be identified:

1. Engineering tasks - individuals responsible for the design and testing of computer equipment.

2. Programming tasks - individuals who analyze and design, produce and maintain the programs and data bases constituting the software.

3. Maintenance and operation tasks - individuals who control and operate the on-going operation of the computer and its peripheral equipment within a computer facility.

4. Utilization tasks - individuals who bring tasks to a computer and receive the computer's output when the task has been executed.

Both the Mayer and Parsons classifications, along with much of the early research in this field, assumes a "mainframe" environment. That is, the research assumes the use of one large computer by many users with a professional computing staff operating and maintaining the system. System users interface with such a system either at a terminal on an interactive basis (sending and receiving electronic information to the central computer), or on a batch basis where input is submitted, the program run, and later the output is received.

The evolution of computing to heavily involve personal computers alters their basic premise slightly. Mayer or Parsons described an individual as being involved predominately in only one of the four tasks. The personal computer requires that the user typically assumes more than one role. Most often the user is performing utilization tasks, however the user must also perform operation tasks in physically operating the system. To a lesser extent the user of a personal computer may perform maintenance tasks in maintaining and servicing the equipment (assembling new equipment or cleaning equipment for example), and occasionally (but less often) programming tasks to generate custom applications.

While changes in technology may have changed the underlying assumption of a singular user function, they do not invalidate the usefulness of such classification. An individual may be involved in several different activities, but the user is normally involved in only one activity at a time. The classification schema, therefore, can be applied providing one realizes that the individual user may shift from one category or role to another, and that any findings will apply to the activity dominant at the time any measurement or analysis is conducted.

Of the four tasks, the one growing fastest and receiving the least amount of emphasis with respect to training is the category of utilization tasks. On the dimension of major user groups, utilization tasks will be the primary concern of this study.

General Computer Functions. Parsons (1970) identifies four general functions of data processing, what computer-based data processing systems do. The four general functions are:

1. Process control - applications where the computer controls the operation, timing, or sequencing of a process such as machine tools, industrial robots, chemical processes, or communications switching.

2. Inventory maintenance - all computer applications where the salient feature is the collection, pooling, and filing of data in storage.

3. Arithmetic calculation - tasks which involve extensive numeric or logic computations including complex equation solving, simulations, engineering analysis, and statistical analysis.

4. Verbal or graphic manipulation - the translation, creation or comparison of nonmathematically structured data, automatic programming, text editing, and computer program construction.

Prior human factors research has been primarily concerned with the general function of verbal and graphic manipulation, specifically computer programming and text editing. The areas of process control and arithmetic calculation, to a great extent, are the realm of individuals much more inclined to be computer literate. Review of the literature show that little research has been directed toward individuals involved in the general function of inventory maintenance, perhaps the fastest growing of the four functions as measured by the number of individuals actively engaging in that task. Therefore, based on this schema, it seems both appropriate and important to extend the current range of research to include inventory maintenance tasks - the routine entering and filing of data - as an area of research sorely in need of additional investigation.

Primary Computer Application. A classification schema is presented by Shneiderman (1987) related to groupings of primary applications. Dimensions used for segmentation included concern for system quality, motivation level of system user, frequency of use, and expectations of system performance.

1. Life-critical systems - includes air traffic control, nuclear reactor control, medical applications, police and fire dispatch, and military operations. In these applications high costs and high reliability are expected, creating a commitment to lengthy training in order to achieve error-free performance.

2. Industrial/commercial uses - includes banking, insurance, order entry, inventory management, and point-of-sales terminals. In these cases costs often shape judgement such that tradeoffs are made sacrificing reliability and quality for preferred lower cost. Ease of training and speed of performance become extremely important because of typically high volumes of transactions with their significant impact on cost.

3. Office, home, and entertainment applications -include word processing, video games, educational packages, information retrieval, and small business management. Ease of learning, low error rates, and subjective satisfaction are paramount because use is frequently discretionary and competition is fierce.

4. Exploratory, creative, and expert systems - include database utilization, statistical analysis, graphical presentation, computer

aided design, music composing, medical diagnosis, and financial decision making. Users possess both high motivation and high expectations with respect to using the system. The broad range of applications in this category makes it difficult to generalize about and evaluate such systems.

While research on training in all four categories of computer application is important, the broad range of applications in the latter two categories make them extremely difficult to research. Professionals in the life-critical systems category of use are already committed to training and ensuring the quality of such training. Significant findings related to the industrial/commercial category could have the effect of both improving the ability of millions of users to perform their routine tasks and potentially to do so at a lower level of cost. For these reasons the industrial/commercial sector will be the primary application area of concern to this research.

<u>Summary</u>. Based upon the above three classification schemes, this study was concerned primarily with one category along each dimension. The scope of this study focused primarily on computer users concerned with utilization of the computer as a tool to support other activities, as opposed to computer professionals where the computer is the object of their concern. This study was concerned primarily with the inventory maintenance function of computer use--the storage, organization, and retrieval of information from the system. Finally, this study focused primarily on computer applications in the industrial and commercial setting. Findings of the study, if significant, could

potentially be expanded and replicated for each of the other 63 cells in the above schema to determine their generalizability to different user communities.

Human Performance Engineering

This study is part of a growing research field known as human performance engineering, a subfield of human factors research. Much of the research in this area has been conducted by Bell Laboratories through their Human Performance Technology Center organized in 1967, and their Human Performance Engineering Department organized in 1975.

> Human performance engineering includes the scientific study of performance-related processes and functions; the translation of research results into meaningful human performance data, design principles, methodologies, and information in systems. (Bailey, 1982:24)

The results of this research should be of immediate importance to researchers in this field.

Figure 2.2 presents a model of the scope, concepts, representative concerns, and participants involved in human performance engineering.

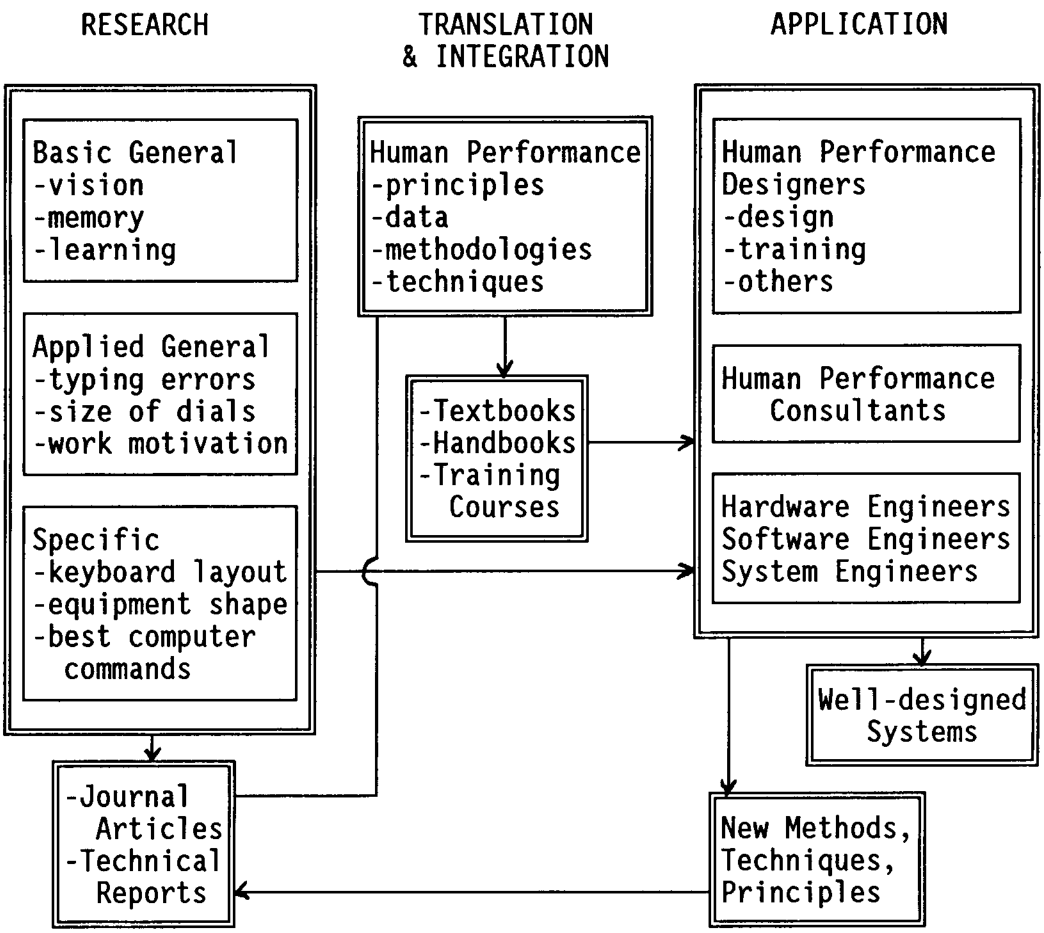

Figure 2.2 Human Performance Engineering (Bailey, 1982:25)

As illustrated by Figure 2.2, human performance engineering is concerned with research and activities at three different levels: (1) conducting research through scientific study, then (2) translating the results of that research into terms that can be understood and used by human performance professionals, so that (3) the results can be applied to improving system design.

Scientific study. Human performance engineers are concerned with conducting scientific research, generally following a reductionist scientific method which includes the following basic elements

(Shneiderman, 1987):

- lucid statement of a testable hypothesis
- manipulation of a small number of independent variables
- measurement of specific dependent variables
- careful selection and assignment of subjects
- control for biasing
- application of statistical test.

Three basic types of research are conducted, delineated by the extent to which results can be generalized beyond the specific human/activity/context situation in which they were developed (Bailey, 1982). The first level, "basic general" research is concerned with human characteristics as they relate to performance. Such research includes areas as memory, sensory capacities and limitation, decision-making, and problem solving abilities. The results of such research tend to be general and considered representative of other people in similar situations.

The second level of research, "applied general" research, is still general in nature but tends to focus more on either activities or context. Examples of research in this area include the content and layout of instructions, and the effects of different instructional techniques. The third type of research, "specific" research, is usually conducted to answer a particular question. Results are specific to the human/activity/context situation in which the research was conducted, and are not easily generalized to other situations.

Research in this study is best classified as "applied general", examining the relationship between different instructional methods (an activity) and human performance. Findings from basic research related to individual differences and personality were used in this study to develop hypotheses for testing with respect to performance as a result of different instructional delivery methods.

Translation. Once research findings have been developed, they need to go through a difficult translation so that they may be used in application (Alluisi & Morgan, 1976). Specific research findings are most easily translated as they generally apply to a specific design question and can be used in that application. With general or basic research (which includes the expected results of this study), findings must be translated specifying appropriate generalization and limitations of the findings. In specifying under what conditions a particular instructional technique is appropriate, the translation must include all relevant considerations and restrictions which must be imposed in applying those findings.

Application. Perhaps the most important activity of human performance engineering consists of applying knowledge to the design of human performance in systems (Bailey, 1982). Through the development of new methods, techniques, and principles, and the dissemination of such knowledge through publication and training, the human performance engineer is able to make improvements in human performance.

Computer Training

> Knowledge about computers and skills in using them does not come about naturally as does hair on the human head. This is a fact of life. And the learning process involved in acquiring knowledge and skill in the computer domain is, contemporarily at least, a very difficult one." (Carroll, 1984:125)

In a comprehensive review of the literature on personnel training, Kenneth Wexley (1984) defines training as "a planned effort by an organization to facilitate the learning of job-related behavior on the part of its employees." Job-related behavior is used in the broad sense to include any knowledge and skills acquired by an employee through practice. Therefore, training consists of a planned activity with the desired outcome of changing job-related behavior.

There is a difference between training and technology transfer. Training is the action, technology transfer results in behavior change (Peters, 1984). Training is always possible, technology transfer may or may not be possible depending on the trainee and the nature of the training. We need to plan training so that technology transfer occurs, so that the desired behavior change occurs in the trainee. Unfortunately, methods for planning training which ensure technology transfer are not clearly defined at this stage. This research will serve as one small step in developing a planning methodology.

<u>Need for Training</u>

According to a recent report by the engineering firm of Stone and Webster in New York on training, training is an important prerequisite that is often overlooked or minimized by managers. "A major cost component that deserves serious management consideration involves the training of employees who utilize microcomputers in order to assure their continuing productivity and ability to perform the specialized services assigned to them in an effective and efficient manner." The report estimates that formal training programs versus allowing the employee to simply learn from the manual could result in a training cost reduction of over 50 percent (Churbuck, 1986).

While corporations in this country spend as much or more on education as colleges and universities, much of the training employees receive seldom has any direct bearing on how they can use a system to get their work done (Kazlaukas & McCrady, 1985). In a survey of seventy managers in business who use computers on the job (Hughes, 1986), 56 percent indicated that the training they have received was in-adequate, and 55 percent indicated that the computer training received was worse than training they had received in other areas. Twenty percent of the managers received no formal training, and only 34 percent received formal training in-house.

Because many people are able to perform computer exercises after only a few hours of trying, managers are often led incorrectly to the conclusion that users can become proficient and productive without intensive training. The time necessary to reach mastery can be greatly diminished through a properly planned and executed training program (Callaghan, 1985).

As modern organizations rapidly advance toward information systems dependency, they often bypass effective instruction of computer use (Hall, 1985). Inadequate training, or unsuccessful attempts at training can almost singlehandedly invalidate man-months and man-years of investment into system design and construction (Scharer, 1983). To keep this loss from occurring, it is imperative that we begin now to ensure that effective training design is possible.

Need for Training Research

How computer users receives training, and within what time frame, are issues that must be addressed. As presented by Hughes (1986), specific questions that need to be answered are:

1. What type of training is best suited for training specific groups of users - seminars, workshops, computer-assisted instruction, or a combination of the above?

2. How long should the training program be?

3. Do employees and managers at different levels of the organization require different types of training?

4. Do employees and managers actually transfer the training they receive to their job environment?

For successful development of knowledge in this area it is important that researchers take seriously the questions of interaction between types of individuals on the one hand and instruction methods and program features on the other (Allwood, 1986). By examining different training delivery methods and individual characteristics, this research will be examining questions posed in the literature.

Training Objectives

In developing a training system, the appropriate orientation is directing and supporting the natural learning styles and strategies of users, for example, giving them less to read if they don't want to read or letting them try real tasks immediately, if they want to do that (Scharer, 1983; Carroll, 1984). Comparing specific recommendations for training development (Knowles, 1983; Scharer, 1983; Baxter, 1984; Callaghan, 1985; Carroll, 1984; Paznik, 1986; Hughes, 1986;

Shneiderman, 1987), the following common guidelines appear:

1. Know your audience. Training program development should begin with a model of the user. Users, rather than data processing managers, are in a better position to understand what it is they want the computer to do and what information they need to make it do such. Therefore, training design requires substantial planning efforts in cooperation with the target audience. Computer manufacturers are vying with each other to produce machines that are more "user friendly". The important issue is not user friendliness but learner-centeredness.

2. Focus on real tasks and activities. People are most concerned with getting the job done, therefore in training you need to present only the information required to get the job done well. The learner wants to know how to get the job done and nothing more. Success and response to training depend upon the use of relevant examples. Through use of actual company data, learners can identify and relate to examples as important elements of the training design.

3. Let the learner lead. Training should be designed to allow the learner to determine what is most important by, preferably, controlling in what order items are to be learned (with appropriate help provided in making such a decision). Flexibility in the form of well indexed manuals, identifiable learning units, and the ability to utilize a task familiar to the learner (as opposed to an arbitrary one) as learning examples all permit the learner to become more self-directing and tailor-make training to support their prior life experience.

4. Put the user at ease. A major objective of training must be to make the user comfortable enough with the system so that the user's

time is spent accomplishing the desired task and not in trying to figure out what command to enter next or what button to push. The user must understand how to interact with and guide the software. To do so requires that the learner be made to understand the purpose of the program, how to enter, manipulate and save data, and most important, how to correct mistakes. Other important factors are to keep the learner aware of what's coming up, making sure the learner understands why and how learning different functions will help them, and ensuring the learner meets with a high level of early success in using the system in order to help in building confidence.

Based primarily on experiential findings (as opposed to planned, scientific research), such guidelines are useful in at least setting minimum development objectives for training based upon what seems to work. Empirical research in the future will hopefully examine such guidelines in a more rigorous fashion.

Instructional Delivery Methods

While instructional delivery methods have been identified and their relative effectiveness discussed in the literature, such discussion has been inconsistent and sporadic. Such irregular research causes comparisons of findings to be difficult (Carroll, Paine & Ivancevich, 1972). Discussion of instructional delivery methods applied to training computer operators has been totally experiential in nature, recounts of methods or results found successful in a single situation. Studies empirically testing the relative effectiveness of different delivery methods in educating computer users could not be found. Therefore, this study will provide a contribution to knowledge by beginning to empirically test the relative effectiveness of different delivery methods.

Categories of Delivery Methods

Training delivery methods can be grouped into two major categories: group-paced mode and self-paced mode. Table 2.3 presents a list of commonly cited methods in the literature grouped into these two major categories.

Table 2.3 Major instructional delivery methods presented in the literature.

Delivery Method	Studies 1	2	3	4	5	6
Group Paced Mode						
Lecture	■	■	■	■	■	
Conferences & Workshops		■			■	
Movie	■	■				
Videotape	■				■	
Panel	■					
Case study		■				
Sensitivity Training		■				
Television		■				
Role Playing		■				
Self-Paced Mode						
Manuals	■			■	■	■
Programmed instruction		■			■	
Disk tutorials				■		■
Computer-aided instruction	■		■			
Computer games		■				
Videotaped modules	■			■	■	
Audiotape with supplements	■					
Slides & Slide/tape	■					

Studies: 1 - Bailey, 1982
2 - Carroll et al., 1972
3 - Churbuck, 1986
4 - Callaghan, 1985
5 - Kazlauskas & McCrady, 1985
6 - Shneiderman, 1987

Over 30 years ago, B.F. Skinner (1954) identified four scientific principles of learning that must constitute the core of any educational technology:

1. The learner must be allowed to be active.

2. The learner's activity must be guided by frequent and immediate reinforcement of correct responses.

3. Material must be presented in graduated sequence, from the most simple and general to the most complex and detailed.

4. Each learner must be allowed to control the rate at which he or she progresses through the material.

While the first three principles can apply equally to both group-paced and self-paced modes of instruction, the fourth principle - learner control of the rate of learning - gave rise to wide spread acceptance of self-paced instructional methods, originally presented as programmed instruction and later progressing to individualized instruction (Bangert-Drowns et al., 1982).

The computer fits Skinner's prescription for scientific instruction better than earlier technologies. The computer can require students to respond actively, reinforce correct responses, work at the students' rate and adjust to their level of understanding, follow a systematic plan, and provide both instruction and review. "The computer can be an infinitely patient tutor, a scrupulous examiner, an engaging performer, and a tireless administrator in the classroom" (Bangert-Drowns, et al., 1982).

The predominant characteristic of the self-paced mode is that each student proceeds at his or her own pace. Students typically learn from previously prepared materials that are divided into modules which require mastery of each before the student moves on, modules that provide for continual student activity and self-checking of progress (Bailey, 1982). Manuals and other print forms of training are most commonly used as self-paced modes of training computer operators, followed closely by disk-based tutorials and training systems.

The group-paced mode is characterized by the fact that trainees constitute a group and move at the same pace. As illustrated by Table 2.3, different forms of instructor-led training are the most commonly used methods of group-paced instruction.

Several empirical studies have been conducted comparing programmed instruction with conventional lecture, each having mixed results. In 20 studies which compared programmed instruction to conventional lecture in an industrial setting, seven showed at least a 10 per cent higher rate of learning with programmed instruction, and the remaining showed no practical difference. In 18 of those studies, programmed instruction was superior to conventional instruction based on comparisons of total time to train, and in the remaining four no significant difference was detected. Nash and his colleagues point out, however, that the conventional lecture case in many of these studies was not well planned and carried out, therefore the results may not be a fair comparison. While programmed instruction is an effective technique, it does not seem to be as superior as training directors believe it to be (Nash et al, 1971).

In a survey of 117 training managers of Fortune 500 companies, programmed instruction was rated most effective and lecture ranked as least effective of 9 methods with respect to acquisition of knowledge. Results were similar for record retention. However, such opinions by trainers are not supported by research where the lecture method has more effectiveness for acquiring knowledge, and for participant acceptance (Carroll et al., 1972). Based on these studies there appears to be evidence that perceived effectiveness of methods, especially by trainers, is inaccurate when compared to actual results.

A major purpose of this study was to compare the effectiveness of different instructional delivery methods. As two major delivery modes of instruction were identified in the literature, the study was designed to compare methods selected from each mode. Based upon common usage and resource constraints in the experimental design, delivery methods selected for comparison were instructor-led or instructor-based training (representing the group-paced mode), and manual-based training (representing the self-paced mode).

Manual-Based Training

Print has been and remains a most common medium for training (Kazlaukas & McCrady, 1985). Software companies, most often held responsible for developing training solutions, consider user manuals to be the answer (Churbuck, 1986). For at least a decade, data processing professionals have emphasized long, thorough, formal user guides as central to in-house training programs (Scharer, 1983).

Manual-based training is most appropriate for those inclined to self-instruction. Major advantages of manual-based training include: minimal staff requirements to support use, flexibility in scheduling, the feature of being self-paced, and typically the requirement of little special equipment (Callaghan, 1985). Manuals are also appropriate when end users are geographically removed from system support, or when instructors are unavailable (Scharer, 1983).

A major disadvantage of manual based-training is that people are often unwilling to take the time and effort to read them. For example, during a training and observation period which lasted three years in a business setting, it was observed that only 10 to 15 percent of the user trainees read the manuals prepared for them. The manual was invaluable to the instructor-analyst, but of little value to the trainee (Scharer, 1983). Experienced computer users generally try to use a program before ever opening the accompanying documentation, not because they're so knowledgeable they can ignore it, but because they don't see the sense of "starting off on a bad note" (Hall, 1985).

While documentation is improving, for the most part it is still poorly written. Most documentation available is designed for reference, not for training (Kazlauskas & McCrady, 1985). Also, manuals often become obsolete. As changes are made to the system and in operating procedures, manual editors are not brought in to update manuals. Consequently most manuals are out of date only months after being written (Scharer, 1983).

Instructor-Based Training

Because of the flexibility, adaptability and responsiveness available with instructor-led training, many training specialists believe that no other method brings users up to speed as quickly (Pepper, 1986). Scharer (1983), in a review of training methods, states that:

> Live system demonstrations and personal interaction are considered the most useful elements of the user's training period. This is backed by some of the basic principles of teaching and learning. Psychologists tell us that if a new concept can be experienced in many ways (see it, hear it, say it, write it), the learning process is more rapid and permanent.

In training computer operators, some complex instructions which are best presented through demonstration as written descriptions would be too cumbersome, too involved, or too lengthy to comprehend (Callaghan, 1985).

A major advantage to instructor-based training is that it can affect learning in both the cognitive and the affective domains. While both manual and instructor-based methods can affect cognitive learning (computer tasks), an instructor can also effect affective learning, especially as it relates to attitudes and fears toward computers (Kazlauskas & McCrady, 1985). This might explain why other authors have found that instructor-led training is often best for groups of new users (Callaghan, 1985).

Disadvantages of instructor-based training focus primarily on the trainer, and the scheduling and location of training sessions. Quality of instructor-led training varies considerably with instructors, the interest and experience level of students in the group, and the type of handouts and other supporting materials used. Typically group training lacks the component of user-control, not accounting for individual differences such as people with pre-learning or who have high speeds of learning (Kazlauskas & McCrady, 1985). Within companies, user training is often perceived to be the responsibility of the data processing department, but such departments are often overburdened or lack appropriately qualified staff to develop and implement a continuing training program. With ongoing classroom instruction, content and timing of training sessions often fail to coincide with the learning needs of employees (Hall, 1985).

Comparing the Two Methods

Experiential findings and limited scientific research results indicate lack of consensus over the relative effectiveness of instructor-based training versus manual-based training.

Manual-based training has been found to be superior in settings where employees preferred to learn by themselves rather than as part of a group (Paznik, 1986), or where self-motivated learners exhibited a high need to exhibit control of the speed of learning (Callaghan, 1985). Instructor-based training has been found to be more effective for computerphobic learners where the trainee needs to be constantly reassured and made to feel the activity is fun (Callaghan, 1985), or in cases where people simply did now want to read but preferred to be shown (Baxter, 1984).

Several authors suggest that the two delivery methods are most appropriately used together: manuals as a tool to supplement instructor led training (Baxter, 1984), and the availability of instructors to assist individuals learning from manuals when they require help (Callaghan, 1985). What is lacking is a theoretical framework through which these different results can be combined into a consistent theory of user training.

Individual Differences

> The remarkable diversity of human abilities, backgrounds, motivations, personalities, and workstyles challenges interactive system designers. A right-handed male designer with computer training and a desire for rapid interaction using densely packed screens may have a hard time developing a successful workstation for left-handed women artists with a more leisurely and free-form work style. Understanding the physical, intellectual, and personality differences among users is vital. (Shneiderman, 1987)

As the population of computer users becomes more heterogeneous with respect to backgrounds, abilities, cognitive styles, personalities, and interests, the greater the impact becomes of such differences on the effectiveness of the system. The multitude of differences between people must be taken into account, and the better they are taken into account the higher the likelihood of a successful system (Bailey, 1982).

Prior research on computer users has investigated a large number of learner characteristics. Individual differences discussed and examined in recent articles include: age (Gomez et al., 1986; Egan & Gomez, 1985), anxiety (Paxton & Turner, 1984), attitude (Paxton & Turner, 1984; Nowacyk, 1984; Gomez et al. 1986; Schneiderman, 1979), closure (Paxton & Turner, 1984; Schneiderman, 1979), cognitive style (Coombs et al., 1981), sex (Goodwin & Sanati, 1986; Dambrot et al., 1985), learning strategy (Deck & Sebrechts, 1984), locus of control (Nowacyk, 1984; Coovert & Goldstein, 1980; Schneiderman, 1979), motivation (Goodwin & Sanati, 1986), personality types (Hoffman & Waters, 1982), prior computer experience (Goodwin & Sanati, 1986; Nowacyk, 1984; Gomez et al., 1986; Rosson, 1984), spatial memory (Gomez et al., 1986).

This study attempted to identify characteristics of people that account for differences in performance in learning to use a computer system as the result of two different instructional delivery methods. Based upon individual differences examined in prior research related to computers, and a review of the literature on training and variables which significantly impact the effectiveness of training, the following five individual characteristics were selected for study: cognitive style, anxiety, prior computer experience, age, and sex.

Cognitive Style

The study of cognitive style emerged during the 1950s (Goodenough, 1976). Work in the area of cognitive style is concerned with the proposition that different individuals have distinctive manners, approaches, or styles of perceiving and processing information (Long, 1983). Witkin, Moore, Goodenough, and Cox (1977) characterize cognitive styles as: (1) they emphasize form rather than content (how rather than what we perceive or think); (2) they are pervasive dimensions in that they are features of personality as well as cognition (as it is a trait of personality as well as a characteristic of cognitive style that an individual likes to be among people, is particularly attentive to what others say and do, and takes account of information from others in defining his own beliefs and sentiments); (3) they are generally stable in an individual, but can be changed over time; and (4) they are bipolar (each may be judged to be positive and to have adaptive value under specified circumstances). Cognitive styles may be described as qualitative differences in the process of cognition as opposed to levels of cognitive ability or skill (Schmidt, 1984).

The literature on cognitive style is extensive. As discussed by Coombs et al. (1981), most writers have developed definitions in terms of polar dispositions which appear as variations on a theme. Examples of these are:

convergent thinking -	divergent thinking	(Hudson, 1966)
vertical thinking -	lateral thinking	(deBono, 1967)
analytic -	gestalt	(Levy-Argesti & Sperry, 1968)
verbal -	spatial	(Paivio, 1971)
sequential -	simultaneous	(Luria, 1966)
operation learning -	comprehension learning	(Pask 1976a,b)
field dependence -	field independence	(Witkin et al., 1977)

Study of the above dichotomies shows each to have features in common. Each set of polar dispositions can be described in terms of two contrasting modes of cognitive function: (a) a mode that is active, analytical, articulated, specific and critical, and (b) a mode that is passive, global, vague, diffuse and uncritical. However, the measures are not identical. It has been pointed out (Wallach, 1962) that mental operations given an identical interpretation on this scheme do not always correlate and similar correlational tests yield evidence for a given theoretical placing on one occasion but not on another.

Computers and cognitive style. A key to designing effective training delivery methods for computer operators is an understanding of the underlying theories and principles about the ways in which an individual learns computer tasks. It is reasonable to assume that individual differences in the learning of computing skills are related to the strategies adopted by the learner in handling computing information. A pattern of such strategies will make up an identifiable cognitive style (Coombs et al., 1981). By understanding the cognitive styles implemented by learners during the learning task, we should be better able to design and prescribe effective training methods. In relating cognitive style to instructional planning and learning, Long (1983) notes:

> The theoretical trend favors the proposition that individuals have distinctive cognitive styles and that they accordingly will interact with different educational techniques in a manner consistent with the dominant cognitive style they possess. If this proposition holds true, then educators who have for years attempted to individualize instructional and learning activities will find themselves challenged to do more prescriptive planning (p. 70).

Unfortunately research relating cognitive style to instructional methods in general, and specifically to training of computer operators has been limited.

In one of the few studies examining cognitive style and computer users, Coombs, Gibson and Alty (1981) were interested in identifying relationships that could guide the design of computer systems to make them more user friendly. Their research was motivated as a response to the increase in heterogeneity of computer users, individuals who were experts in other areas such as medicine or social science but not skilled in computing. Given subjects with apparent equal capability to learn, they were interested in contrasting learning strategies used by successful and unsuccessful learners so as to be able to identify cognitive skills required for acquisition of computing ability. They were also interested in developing ways of identifying, in advance, individuals needing special attention so that relevant training programs could be prescribed to improve the success rate of learning.

As a measure of cognitive style, Coombs et al. selected Pask's (1976a,b) Spy-ring History Test. The test is completed in one session of two and one-half hours, the time divided between a learning phase and a test phase. In the learning phase material is verbally presented about a communication ring between five spies in three countries over three years. The material consists of background information relating to the character of each of the spies, the political economic situation in each of the countries, and representations of the communication network between the spies. The communication information is presented as a series of eight transactions each year of one spy passing a message to another in a specified country. The information is presented simultaneously on an overhead projector as both a list and a graph showing who passed messages to who. During training each subject is asked to reproduce both the list and the graph correctly as soon as it is removed from view. It is unlikely that subjects are able to reproduce the list and graph after only one exposure as they are intentionally overloaded with information. Subjects are given as many exposures as necessary until they are able to successfully reproduce the material.

Following the learning phase, subjects are asked to complete a test booklet. The questions test for rote learning of background information, reproduction of lists and graphs, and ability to make deductions from the lists and graphs.

The test is designed to measure two basic dimensions of human information-processing: (a) a dimension concerned with the management of data selected from the world (attention); and (b) a dimension concerned with the mental representation of that data (mental model-building). The attention dimension draws distinction between the local features of the subject material and the global features. When recalling an example given during training, a subject who clearly remembers the context of the example but not necessarily all its details would be considered to have remembered in a global mode, where the subject who remembered the salient points but not necessarily the context would be considered to have remembered it in a local mode. The representation or model-building dimension draws the distinction between the presentation of information as a system of rules (what it does) and as a description (what it is). Where a rule-building oriented subject would remember the specific steps involved in the material, the description-building oriented subject would focus more on what the steps were designed to accomplish. By relating the two dimensions Pask presents four cognitive modes (figure 2.3.).

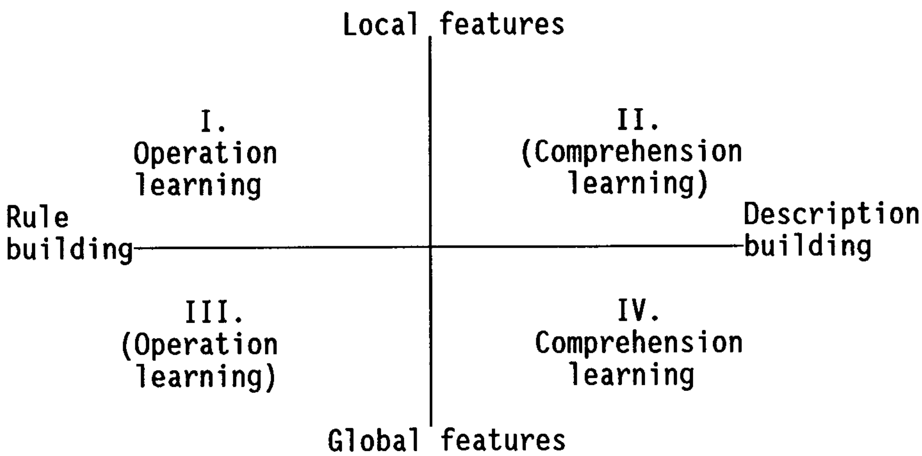

Figure 2.3. Schematic Representation of Information-Processing Dimensions (Adapted from Pask, 1976c)

Pask argues that most individual learning styles will fall in either quadrants I or IV. Rule-building is most effectively undertaken using specific, local information. Description-building is most effectively undertaken with attention to global features. He uses the terms "operation learning" to describe subjects in quadrant I, and "comprehension learning" for subjects in quadrant IV.

In their study, Coombs, Gibson and Alty examined the relation between cognitive style and the ability of learners to program a computer using the FORTRAN computer language. Specifically, they correlated comprehension learning and operations learning with the ability of subjects to find errors in FORTRAN statements (Statement Test) and to place those statements in the correct order (Logic Test). The researchers hypothesized that students who were primarily operation learners would have an advantage on the Logic Test but would have no advantage on the Statement Test.

Operation learners would be expected to pay close attention during the learning of individual language structures to their internal logic. Comprehension learners would only attempt to remember the global features of the structures as given. In performing the Logic Test, comprehension learners would be at a disadvantage because they would be expected to store global features of the learning context in their representation of the language structures, making them less flexible owing to interference with the context of the test problems. Findings of the research which included replication, while far from conclusive, provided preliminary support for the researchers' hypothesis that there exists a correlation between scores on the operation learning scale and performance on the Logic Test of ordering FORTRAN program statements.

Coombs, Gibson and Alty's research lends preliminary support for a relationship between cognitive style and how individuals learn to operate computers. However, the findings are severely limited. Their research was based on extremely small sample size, eleven subjects in their first study and eight subjects in their replication. The studies employed a measure of cognitive style not widely used. Further, computer programming was selected as the target task in the research while current trends would indicate that programming will be performed by fewer and fewer computer users, who instead will make use of commercial software packages and systems. It is proposed that the research could be improved were it to include larger sample sizes, use a more widely used test of cognitive style, and make use of a commercial-like computer software package as the target task. Such objectives have been incorporated into this research.

Field dependence, field independence. Among the cognitive styles identified to date, the field dependence-independence dimension originally investigated by H.A. Witkin and his associates has been the most extensively studied and has had the widest application to educational problems (Witkin et al., 1977).

Early work on this dimension was concerned with how people locate an upright in space, how they determine what is straight up and down. People determine which way is up on the basis of information they receive from visual cues around them. People also make reference to sensations from within the body, as the body continually adjusts itself to the downward pull of gravity in maintaining upright posture and balance. Normally the standards received from external cues and internal references coincide. However, when such cues are made to conflict, individuals locate the upright differently.

In their early research, Witkin et al. developed the rod-and-frame test. In this experiment a subject was seated in a dark room in a chair that was tilted at an angle from perpendicular to the floor so as to skew the subject's internal reference of upright. The subject viewed, at a distance, an illuminated square frame that was tilted from vertical, and an illuminated rod in the center of that frame. The task for the subject was to rotate the rod to a position perceived as upright while the frame around it remained in its initial position of tilt.

Early findings showed marked differences in how people performed this task. For some the rod was properly upright when it was fully aligned with the surrounding frame, whatever the position of the frame. Others were able to adjust the rod more or less close to the true upright regardless of the position of the surrounding frame. Witkin found that some people tended to rely entirely on external cues; as they were influenced by information from the outside world he called them field-dependent. Others relied exclusively on their own internal sensory processes, and were unswayed by contradictory external evidence, these he called field-independent. Most people are not at the extremes, but individuals do tend, over a period of time, to be stable in the degree to which they are field-dependent or field-independent.

This research was expanded to broader studies involving the concept of self-consistency, where the possibility was considered that reliance on field or body could also be conceived to involve separation of an item (rod) from an organized field (frame). To test this hypothesis Witkin (1950) developed the embedded-figures test (EFT), and later the group embedded-figures test (GEFT) (Oltman et al., 1971) in which the subject is shown a simple figure and then required to find it in a complex design that is patterned so that each component of the simple figure is made part of a clear-cut subwhole of the pattern; the simple figure is thereby effectively hidden (see Figure 2.4).

Simple Figure Complex Design

Figure 2.4. Sample of simple and complex figures similar to those used in the Group Embedded-Figures Text (Oltman, Raskin, & Herman, 1971)

To locate the simple figure it is necessary to visually break up the organized pattern so as to expose the figure. Studies showed that subjects who had difficulty separating the simple figure from the complex design were ones who could not easily keep the rod separate from the frame in the rod-and-frame test, the ones who were field-dependent. Conversely people who were field-independent in the rod-and-frame test found it easy to overcome the influence of the organized complex design in locating the simple figure.

These findings along with others suggested that the field-dependence-independence dimension was a more general dimension of perceptual-analytical ability that manifests itself pervasively throughout an individual's perceptual functioning (Witkin and Goodenough, 1981).

While not identical, there are great similarities between Pask's classification of cognitive style and that of Witkin, et al. Pask's operation learner, one who pays attention to the internal logic of structures and to their local features, would be similar to Witkin's field-independent learner. Similarly, Pask's comprehension learner would be similar to Witkin's field-dependent individual, one who learns by considering a structure as part of its surrounding context.

Field dependence and learning. Field-dependent and field-independent students are not particularly different in learning ability. They are different, however, in the kinds of material they learn most easily and in the strategies they follow in achieving their learning goals (Witkin, 1977). Field-dependent individuals have been found to do better than field-independent individuals in learning materials with social content, such as recognizing the faces of people.

A distinction has been drawn between a hypothesis-testing and a spectator approach to concept attainment. The first approach requires the learner to form a hypothesis about the correct concept, adopting an active role in the learning process. In the second approach the learner takes more of a passive role. Field-independent learners have been found to be more likely to adopt the hypothesis-testing approach, although such an approach was not necessarily more successful in achieving the correct concept (Nebelkopf & Deyer, 1973).

In a study involving 60 undergraduate college students, Reardon et al. (1982) discovered that field-independent individuals generally performed better on learning and memory tasks than did field-dependent persons. In their discussion they hypothesized that the superior performance of field-independent subjects may be due to their taking a more active approach to learning, where field-dependent subjects adopted a more passive, spectator approach.

Field dependence and interpersonal behavior. In their review of the literature on field dependence and interpersonal behavior, Witkin and Goodenough (1977) present evidence which demonstrates that field-dependent persons show a strong interest in people, that they prefer to be physically close to others, and that they favor real-life situations that will bring them into contact with people. In contrast, field-independent persons are less interested in people, show both physical and psychological distancing from others, and favor impersonal situations. This finding is well demonstrated by research (Witkin et al., 1977) which has demonstrated that relatively field-dependent persons are likely to favor educational-vocational domains that feature social content and that require interpersonal relations, and relatively field-independent persons are likely to favor domains in which social content and relations with people are not especially involved but for which analytical skills are important.

Anxiety

While concerns about fear and anxiety are as old as mankind, anxiety conceptualized as a distinct and pervasive human condition had not been recognized until the beginning of the present century (Spielberger, 1966). It was Freud who first proposed a critical role for anxiety in personality theory as a "fundamental phenomenon and the central problem of neurosis" (Freud, 1936, p. 85), a specific unpleasant emotional state or condition of the human organism.

Prior to 1950 there was relatively little research on human anxiety (Spielberger, 1966). Such lack of research could be attributed to the complexity of anxiety phenomena, the lack of an accepted theoretical conception of anxiety, the lack of appropriate measurement instruments, and ethical problems related to inducing anxiety in laboratory settings (Spielberger, 1983). Since 1950 developments on two fronts have facilitated increased research: conceptual advancements in clarifying anxiety as a theoretical construct, and development of scales for its measurement (Spielberger, 1983).

<u>State and trait anxiety</u>. The term <u>anxiety</u> is currently used to refer to two related, but different, constructs. Anxiety is used to describe unpleasant emotional states. Anxiety is also used to describe individual differences in anxiety-proneness, a more enduring personality trait. This distinction between state and trait anxiety, respectively, was first introduced by Cattell (1966; Cattell & Scheier, 1961, 1963).

An emotional <u>state</u> exists at a given moment in time at a particular intensity, whereas a personality <u>trait</u> is relatively enduring and predisposes the individual to react or behave in a predictable manner. Anxiety states are characterized by subjective feelings of tension, apprehension, nervousness, and worry, and by activation of the autonomic nervous system (Spielberger, 1983). Trait anxiety refers to relatively stable individual differences in anxiety-proneness, the tendency or disposition to perceive stressful situations as dangerous or threatening. The higher the trait anxiety, the more likely it becomes that the individual will experience more frequent and more intense elevations in state anxiety in response to threatening situations.

Persons with high trait anxiety more frequently exhibit state anxiety elevations than low trait anxiety individuals because they tend to interpret a wider range of situations as dangerous or threatening. It is the person's perception of threat, and not the real danger associated with a situation, that determines the intensity of state anxiety.

It has been demonstrated that in circumstances where an individual's personal adequacy is being evaluated (as in taking an intelligence test), or circumstances in which failure is experienced, persons with high trait anxiety are generally more threatened than persons with low trait anxiety (Spence & Spence, 1966; Spielberger, 1962; Spielberger & Smith, 1966). It has been demonstrated that persons with high trait anxiety are more likely to respond with greater increases in the intensity of state anxiety in situations that involve interpersonal relationships and threaten self-esteem (Spielberger, 1983). In situations involving physical dangers, individuals high in trait anxiety do not appear to respond differently from persons with low trait anxiety. Prior research has included tests involving threat of electric shock (Hodges & Spielberger, 1966), and threat of imminent surgery (Auerbach, 1973; Martinez-Urrutia, 1975; Spielberger et al., 1973).

Applying prior research to the process of training individuals, one would expect that trainees with a high level of trait anxiety would exhibit elevated levels of state anxiety when they perceive the training situation as threatening. Sources of anxiety experienced could be the result of the perception of inadequate performance, the fear of failure, or in the case of learning from an instructor, the threat to the trainee's self-esteem of not meeting the instructor's expectations. Individuals with low trait anxiety, or with high trait anxiety but who do not find the training threatening, would be expected to demonstrate low levels of state anxiety.

<u>Computer anxiety</u>. Computerphobia, the fear of computers, first gained attention well over a decade ago (Bloom, 1985). Also known as cyberphobia, it is the fear of automation or of computers as demonstrated by a reluctance to use computer equipment (Little, 1985). With every major advancement and new application of computer technology, there is usually an accompanying negative response which ranges from cautious apprehension to anxiety to downright fear (Alexander, 1982).

The fear of computers has been discussed at length in the literature on a conceptual level. There have been, however, few attempts to empirically test such assertions. The object of concern of the majority of articles has been anxiety as experienced by the novice computer user.

> First meetings between computers and humans often resembles awkward early sex. You don't know where to put your hands or how to ask for what you want. The basic instructions you were given don't seem to fit this particular case, and you're afraid of doing some damage. Most certainly you will make mistakes and, if your fear is great enough, you might not be able to do anything at all. And so the first time you interact with this new partner, you're likely to experience a lot of anxiety (Galagan, 1983, p. 57).

Bloom (1985) identifies three major causes of computer anxiety: (1) lack of facts about the computer's capabilities, (2) lack of success in training, and (3) lack of success in working with computers. Table 2.4. presents common fears associated with computers identified by several authors.

Table 2.4. Fears identified with computers.

Author	Fear of:
Bloom (1985)	Breaking the computer Making costly errors Looking stupid Receiving "beeps" and error messages The computer as being smarter Inability to understand written documentation Losing control Lack of time to learn Disappointment Futility
Zuboff (1982)	Decision making taken over by machines Conceptual skills replace direct experience Computer rules replace personal judgement Computer decisions cannot be challenged Loss of contact with colleagues
Weinberg (1971)	Computer will take away part of job Computer will replace employee Computer will threaten expertise of prestige Embarrassment by having to ask basic questions

The results of computer anxiety may include a reduction in short-term memory, and impaired user performance in operating the computer system (Shneiderman, 1979).

Little (1985) identifies training as the initial step in overcoming fear of computers. He recommends that training exercises need to be designed to ensure that the trainee experiences success in using the computer. Trainees need to be instructed and reassured of the capabilities of the machine. For example, they need to know that safeguards exist so they will not be able to accidentally erase important programs or data from the system. For self-paced learning using either printed or electronic resources, it is often necessary to have a knowledgeable person there to explain and interpret documentation.

Prior Computer Experience

Much research has been conducted related to training individuals with little or no prior computer experience, referred to in the literature as novice of naive computer users (Allwood, 1986; Paxton & Turner, 1984; Nowaczyk, 1984; Jagodzinski, 1983; Mayer, 1981; Kennedy, 1975). Eason (1976) defined the naive computer user as a person who is not a computer expert, but who does use the computer to help in performing certain tasks. Expanding on this definition, the naive user: (1) relies on the computer to aid in accomplishing a task; (2) does not have extensive knowledge in the area of computer technology; (3) desires to limit the amount of time and effort expended in using the computer; and (4) requires substantial training and support in order to use the computer system (Eason & Damodaran, 1981). This study will be primarily concerned with the novice user.

In reviewing the literature on novices on the computer, Allwood (1986) concluded that: (1) novices experience substantial difficulty in using computer systems, in programming, and specifically in correcting errors; (2) difficulties experienced are due not only to deficiencies in domain knowledge (prior use experience), but also to deficiencies in problem-solving techniques (which relates to ability in learning how to use the system); and (3) novices have difficulty communicating with computer personnel, and understanding messages from the computer and other written information. Thus if differences due to prior experience occur, examination of such a finding should include investigation into the effectiveness of communication with the user, and development of problem-solving skills.

Results of research investigating the effect of prior computer experience have been mixed. One study which examined the relation between prior experience with computer-like devices and learning to use a text-editor failed to establish any significant correlation (Gomez, Egan & Bowers, 1985). A regression study designed to predict student performance in a college introductory computer course found computer experience to be a significant contributing factor (Nowaczyk, 1984). In a study of 121 employees who were computer users in a research center, Rosson (1984, 1985) demonstrated a strong relationship with use of a text-editing system and prior experience using other editing systems. Such mixed findings would indicate that the effect of prior computer experience varies with the nature of the setting and task under consideration.

Age

Despite popular beliefs that adults become more entrenched in their ways and less able to learn new things as they grow older, research into adult development and cognition continues to show that learning is possible throughout adulthood (Whitbourne & Weinstock, 1979). Such research can be grouped into two broad categories: those studies which investigate the external conditions that affect the learning process, and studies which examine more closely the actual cognitive processes and structural changes that take place within the learner.

External conditions shown to change with the age of the learner are the impacts of pacing and transfer. Pacing refers to the amount of time a person is allowed to study the material to be learned. As adults grow older, they make fewer errors when they can determine their own pace. When the experimenter sets the pace they do better if it is at a slow speed for both learning and responding (Arenberg & Robertson-Tchabo, 1977). Transfer refers to the improvement of performance on a task due to the effects of having performed some previous set of tasks. Prior experience at similar tasks, providing the opportunity for practice, allows the adult the opportunity to "learn how to learn" (Hultsch, 1974). Negative transfer, in the form of interference, can occur when prior experience conflicts with newly acquired material.

Whitbourne and Weinstock (1979), in reviewing the literature on cognitive processes unique to adult learners, identify the following major concerns:

1. Before adults will commit to learning, they must consider the outcome to be worth the effort. Such need for relevance stems partially form the many responsibilities held by an adult, and the time limitations on what can be reasonably accomplished in a given period or a lifetime.

2. As returning students, adults are often very different in their approaches to education. Adult learners demand more of their instructors in the sense of wanting to know how information and concepts taught apply to specific situations, being critical when such concepts contradict prior "real world" experiences. Adult learners expect to be able to identify and receive direct benefit from their learning experiences by being able to connect what is being taught with how they will be able to utilize that information.

3. Experience plays an important role in an adult's motivation to learn. Adults are more likely to fully engage in new learning situations when they have found similar experiences in the past to be rewarding.

Age and computers. Malcolm Knowles, developer of andragogy - the theory of adult learner, has stated that "the computer industry doesn't understand now adults learn" (1983). In reacting to his experiences in learning to operate a computer for the first time, he observed that educational methods being used violated almost all the rules established for training adults. In reacting to the documentation accompanying the hardware and software, Knowles recorded in his diary:

> I find the manual to be difficult, in that it violates many principles of adult learning; it is very pedagogical: (1) It makes me memorize commands by rote memory without my understanding how I would use them in writing letters, articles and books; (2) It makes me practice the commands by playing games, which I am not interested in. Furthermore, my confidence is shaken constantly when I follow the instructions in the manual or on the screen and the computer does no do what the instructions say it will.

Utilizing the principles of andragogy, Knowles recommends that the following four principles be incorporated into computer system training:

1. Adults have a need to know why they need to know something before they will expend energy to learn it. You need to explain why something must be learned before expecting the adult to learn it.

2. Adults learn things best when they are in the context of what they want to do. Learning should be directed at achieving a desired result, not toward arbitrary games and examples.

3. Adults enter the learning setting with different backgrounds and experiences. Allow choices in training that will allow users to enter a system with different levels and types of experience.

4. Adults have a deep psychological need to be self-directing. Manuals should be written in everyday English and well indexed so that adults can go to and learn the sections they are interested in.

These four principles relate closely to the cognitive processes unique to adult learners identified by Whitbourne and Weinstock above.

Results of empirical research on age as it relates to computer use have been mixed. Gomez, Egan and Bowers (1986) in examining factors that affect success in using a text editor, identified a significant positive relationship between age and both execution time (time to complete increased with age) and first-try errors (number of errors increased with age). Such effects could not be explained by subjects' attitudes, educational background, or a variety of aptitudes.

In explaining the correlation, the authors hypothesized that age is correlated with difficulty or complexity of task. Citing findings that as tasks become more complex, the effect of age becomes more severe (Cerella, Poon, & William, 1980), they concluded that the complexity of the task in the experiment was such that age became a factor. In similar research using a less complicated task (Egan & Gomez, 1985), no age effect was established.

Sex

In the past women have been severely disadvantaged in professional careers due to their lack of quantitative skills (Sells, 1980). There is growing evidence that women are also falling behind in the mastery of computers (Kiesler, Sproull & Eccles, 1983). Although an extensive body of research exists regarding sex differences in mathematical attitudes and achievement, limited empirical evidence is available regarding sex difference in computer attitudes and involvement (Dambrot et al., 1985).

Substantial research has been conducted examining sex-related attitude differences toward mathematics. Based on the study of elementary school children, findings indicate that mathematics are viewed as a "male domain" by both boys and girls, a commonly observed form of sex-stereotyping (Fennema & Sherman, 1977). The feeling of anxiety experienced by females when confronting anything mathematical spills over to computers (Zanca, 1979; Winkle & Mathews, 1982).

The sex-related attitude of mathematics and other "number crunching" activities as being male oriented has been identified in students as early as third grade (Boswell, 1979). Such attitudes, developed early, seem to adversely affect the achievement of girls in high school with respect to quantitative skills (Benbow & Stanley, 1980). It is not yet known whether corrective plans designed to alter these attitudes have had a positive effect as the generation impacted by such plans are still at early stages in the educational system (for an example of a corrective plan see Armstrong, 1980).

Sex and computers. Anecdotal evidence has indicated that there is a sex difference in participation in a variety of computer activities (Kiesler et al., 1983; Rosser, 1982; Winkle & Mathews, 1982). In addition to the argument of computers as being a male dominated domain, it has also been suggested that women, in general, who achieve to gain social approval may be less motivated to achieve mastery of the complex, socially isolated, individualistic world of computers (Dambrot et al., 1985).

In a study of 901 college students, 559 females and 342 males, small but significant sex differences in computer attitude, computer aptitude, and computer involvement were discovered (Dambrot et al., 1985). The study indicated that sex and computer attitude consistently were selected as predictors which discriminated between groups differing in computer experience, usage, and plans to major in computer science. Scholastic achievement measures and math aptitude, however, did not discriminate between groups differing in computer involvement.

While anecdotal evidence on computer use, and empirical findings related to mathematics imply there to be a sex difference in computer attitudes and aptitudes, such evidence is inconclusive. Further empirical research in a variety of situations is needed to further investigate this relationship. Therefore, investigation of sex in this study as one of the variables of concern will assist in further exploring this area of concern.

Methodological Issues to Computer Research

In completing this chapter reviewing the literature related to training computer users, two topics of concern have yet to be presented. These topics relate to methodological issues raised in conducting research on computer users. The first is a discussion of the major approaches used in computer user research. The second relates to the issue of measuring performance.

Major Approaches to Computer User Research

There are several different methodological approaches that have been used in research to study how people acquire information, and specifically computer information. One commonly used technique is "protocol" analysis where subjects are given a computing task and the actions they take or the thoughts they have while completing it are recorded (see Bruner, Goodnow & Austin, 1956; Newell & Simon, 1972). While such an approach has intuitive appeal, protocols generated can be extremely complex and difficult to analyze. Lacking a well-established theory of computer learning it becomes difficult, if not impossible, to analyze such data lacking the means for identifying significant details.

An alternative approach used by many computer research studies is to present the subject with a "target" task and an "indicator" task. As described by Coombs et al. (1981):

> "The objective of the method is the characterization of subject performance on the target task about which little is known, and this is achieved by careful choice of a 'formally' derived indicator task which is expected to have some predefined relationship with the target task. Information from the indicator task will then be used to generate hypotheses about strategy and performance on the target task."

As research into strategies used by computer users is still predominantly in the hypothesis building stage, the target-indicator task approach is most appropriate for current levels of research. As empirically generated hypotheses are developed, protocol analysis may be most appropriate for testing such hypotheses.

Target task. The two most frequently selected target tasks for computer user research have been programming languages and text editors. Table 2.5 summarizes prior research, grouped by target task used. As illustrated by Table 2.5, programming languages have been popular in research as, until recently, it was considered requisite to computer training that computer users have at least some knowledge of programming. Consequently, programming was often the first topic of training for new groups of computer users, which also meant that new populations of subjects were readily available in programming classrooms. Today, however, programming is no longer consider a prerequisite to computer use. Computer users learn to operate software packages that either make use of "higher level" languages (a form of programming specific to the software which actually performs multiple

Table 2.5 Prior experimental research examining individual differences in computer system users.

Study	Subjects	Independent Variable	Dependent Variable
Text Editing as Target Task			
Gomez, Egan, Bowers (1986)	33 adult women computer novices	* Age Attitude toward computers Controlled association Estimated typing speed Experience with computers * Reading skill * Spatial memory Text-editing vocabulary	Reading Time Execution Time First-try Errors
Gomez, Egan, Bowers (1986)	41 adult women computer novices	* Age Associative memory Attitude toward computers Estimated typing speed * Logical reasoning Reading skill * Spatial memory * Years of education Years since classroom course	Reading Time Execution Time First-try Errors
Carroll, Carrithers (1984a)	12 secretaries	* Use of training wheels system Time in training Error rates System comprehension	Time at task
Rosson (1984)	121 computer users	* Prior computer experience * Prior text editor experience Job type	Number of functions used

*Independent variables found to be statistically significant

Table 2.5 Continued

Study	Subjects	Independent Variable	Dependent Variable
Programming as Target Task			
Coombs, Gibson Alty (1981)	28 postgraduates	* Cognitive style	Statement writing test Logical order test
Goodwin, Sanati (1986)	300 college students	* Prior math/computer experience Attitude toward computers Sex	Final course grade
Kagan, Douthat (1984)	326 college students	* Introversion/extroversion Neuroticism Irritability Type A behavior	Course exam scores
Nowaczyk (1984)	286 college students	* Prior academic performance Prior computer experience Attitude toward computers Personal locus of control	Problem-solving test
D'Arcy (1984)	80 college students	Prior programming experience Program modification tests	Programming comprehension
Computer Aided Instruction as Target Task			
Hoffman, Waters (1982)	155 military students	* Personality preferences	Training drop-out rate

*Independent variables found to be statistically significant computer functions with a single command), or are presented in such a way that no understanding of computer language or programming structure is required.

The second most widely used target task is training individuals to operate a text editor. Text editors are the precursors to word processing systems, and are an integral part of many software packages and applications which involve the processing of words (as opposed to - numbers). Operating a text editor could be considered a form of programming using a "higher level" programming language as described above.

Referring to the classification of computer tasks and applications presented earlier, the groups of interest to these target tasks has been predominantly individuals performing either programming or utilization tasks, conducting verbal manipulation functions, in office or exploratory applications. The classification cell of interest in this study (individuals performing utilization tasks to accomplish inventory maintenance functions in the business and commercial setting) makes the use of programming or text-editing inappropriate as target tasks. Therefore, this study will develop and utilize a simple, menu driven, inventory maintenance program to be used as its target task.

Measuring Performance

The dependent variable of concern in this research is performance in operating a new computer system. Performance is often confused with behavior (Bailey, 1982). Performance is meeting your objective -- a result. The actions leading to this result are behavior.

> Performance is defined as the result of a pattern of actions carried out to satisfy an objective according to some standard. The actions may include observable behavior or nonobservable intellectual processing (e.g., problem solving, decision making, planning, reasoning). Things change when people perform. (Bailey, 1982:4).

Subjects in this research were required to carry out a series of actions (keying data into the computer, reading results displayed on the screen) to fulfill the objective of successfully using the computer system. In order to evaluate relative performance using different instructional delivery methods, results need to be compared to some standard. The two most common standards are quality and quantity. Bailey states that at least four standards should be made a part of every system: skill development time, user speed of performance, accuracy, and user satisfaction.

Skill development time. The time required to develop a new skill, often referred to as training time, is a quantity standard of performance. A main goal of the system designer is to find ways of designing activities so that required training time is kept to a minimum. One example would be the use of menu selection systems which, through the use of familiar terminology and step-by-step procedures, are able to eliminate training and memorization of complex command sequences (Shneiderman, 1987).

Similarly, a main goal of the system trainer is to train people in the minimum amount of time possible, as the less time it takes to train people, the lower the cost of operating the system. The trainer needs to constantly be striving to utilize training techniques and programs which bring system users to the desired level of performance in the least amount of time. Use of performance aids and well written instructions can minimize the need for training.

User speed of performance. The speed at which a person completes the desired actions is the second quantity standard of performance. As with training time, the goal of system designers and trainers is to reduce the speed of human performance to the shortest possible time so as to minimize the human cost of operating the system.

Accuracy. Accuracy, a quality standard of performance, is generally measured as either the number or proportion of errors made in a given time. An error is defined as a deviation from an expected outcome; in this research, an error would be counted if the user keys a "2" instead of a "5" and fails to correct the entry to a "2". Inspection of the types of errors made often helps to explain why a person is not achieving the desired level of performance.

User satisfaction. The fourth basic standard is user satisfaction. This standard applies to the work activity and the training experience. Designers and trainers should strive to build systems that will be considered rewarding by the user. Satisfaction is usually measured indirectly using interviews or questionnaires.

Tradeoffs. Designers and trainers would like to succeed in each of the above four categories, however, they are often faced with tradeoff decisions. In some cases the decision to reduce the error rate may result in increased training time and increased performance time. Conversely, the decision to reduce training time may increase both performance time and the error rate. Thus, improving the results of one performance measure may mean lessening the importance of others.

In order to accurately evaluate performance, we must have a clear and consistent set of performance measures. To compare performance between two different user groups, we must evaluate all four standards of performance and take into consideration the tradeoffs which may occur.

CHAPTER 3

PROCEDURES AND METHODOLOGY

The purpose of this study was to determine if differences in performance using a computerized management system would occur as a result of two different training methods. The study also examined the relationship between differences in performance and individual characteristics of the subjects including level of field dependence, state and trait anxiety, prior computer experience, sex, and age. Where differences were discovered between training delivery methods, further analysis was conducted to determine if such differences could be attributed to individual differences between subjects. To examine these issues an experimental research design was used.

Experimental Design

This study involved two groups of subjects, one considered the experimental group and the other the control group. A correlated-group design using matched groups of subjects in the experimental conditions was used (Christensen, 1980). Subjects were pretested on the independent dimensions of field-dependence and trait anxiety. Subjects' scores on these variables were matched. Matched groups of subjects were randomly assigned to the experimental and control groups.

Subjects in the control group were trained to operate a computerized management system by reading a training manual and working practice problems on the computer. Subjects in the experimental group were trained to operate the computerized management system by an instructor. For all subjects the content of the training was held constant. In the experimental group the instructor presented material as closely as possible to the way it was presented in the training manual used by the control group. All subjects completed the same practice problems on the computer.

For both experimental and control groups, performance was measured by a test in which subjects completed a series of representative tasks. The main dependent measures were time at training, time at task, and accuracy in completing assigned problems.

Materials and Instrumentation

A computerized management system was specifically designed for use in the study. Two training delivery methods were used to instruct subjects in the operation of the computerized management system. Two standardized instruments and a demographic questionnaire were utilized for the collection of data.

The following discussion describes the computerized management system, the training delivery methods, and the measurements obtained through their use. Also discussed are the standardized instruments' purposes, formats, scales, reliability and validity.

Computerized Management System

A computerized management system titled Master Beverage Management System (MBMS) was developed for this study. MBMS is representative of price and inventory computer systems used in the restaurant industry. The content of the system, beverage management, was selected because of expressed interest in the topic by subjects in this study, college students enrolled in courses in hotel and restaurant management.

A new system was developed as opposed to using a commercially available system in order to: (1) ensure that subjects had not had prior experience in using the system, (2) to ensure that the system training manual was designed to incorporate current theory and practice related to computer system documentation (for example see Shneiderman, 1987), and (3) to allow the computer to automatically capture and record measurements of the dependent variables in this study.

The section of MBMS used in the study is one of four modules in this comprehensive bar management system. Subjects were trained to use six major functions in the system as listed in Table 3.1.

Table 3.1. Major functions included in Master Beverage Management System

1. Liquor Receiving - recording of the arrival of new liquor shipments into inventory
2. Liquor Costs - recording of changes in cost of liquor paid by the establishment to the liquor purveyor
3. Drink Category Pricing - setting and changing of drink prices by major category
4. Daily Usage - recording of daily usage of alcoholic beverages
5. Daily Liquor Order Report - preparation of the order report to determine next days purchases of alcoholic beverages
6. Daily Cost Analysis - preparation of report showing percentage cost figures for the day's sales activity

Subjects first completed training using one of two training delivery methods, each of which included working practice exercises. Following completion of training a test was administered where subjects were required to complete a series of representative tasks using MBMS. During both the training session and the test session subjects were required to utilize each of the six functions of the system.

Manual-Based Training (MBT). Included in Appendix A is the training manual for the Master Beverage Management System. The manual was developed to incorporate many of the design concerns discussed in Chapter 2. Subjects in the MBT group were required to learn how to operate the system solely through information provided in the training manual. While a lab monitor was present during training and practice times, the monitor only responded to specific questions and assisted subjects when they were unable to proceed on their own. The monitor tried to not provide any input or information not available in the manual.

Instructor-Based Training (IBT). Subjects in the IBT group received substantially the same training as subjects in the MBT group, however, in this group instructions were delivered by an instructor. The instructor essentially read the manual to the subjects, pausing to answer questions subjects raised as the training progressed. IBT subjects completed the same practice exercises during training as did MBT subjects. In the IBT group, subjects did not have a written manual to refer to.

Representative tasks. Following completion of training, all subjects were required to complete a test which was composed of a series of representative tasks using MBMS. These tasks were provided in written form in a format that would be typical in a commercial setting. The tasks received by the subjects are presented in Appendix D.

Performance measures. The main dependent variable of the study was level of performance in learning and using the computerized management system. Based upon the review of the literature and performance measures used by researchers in similar situations, three measures of performance were selected and measured: (1) learning time - the total amount of time a subject spends learning to operate the computerized management system, (2) execution time - the total amount of time a subject spends in completing a series of representative tasks utilizing the computerized management system, and (3) error rate - the number of uncorrected errors remaining upon completion of the representative tasks.

Both learning time and execution time were measured automatically by the computer. The computer recorded the time each subject began and ended the training session. The computer recorded the time each subject began and ended the session of completing the representative tasks. In each case by subtracting the start time from the end time, the total time required was determined in minutes and seconds.

In completing the representative tasks subjects were required to make 48 data entries. Following completion of the representative tasks the computer scored the number of errors remaining in the final system record. Entries incorrectly made but properly corrected were not counted as errors.

Group Embedded Figures Test

The Group Embedded Figures Test (GEFT) (Witkin et al., 1971) is an adaptation of the individually administered Embedded Figures Test (EFT) developed by Herman A. Witkin in 1950. The EFT and GEFT are perceptual tests designed to measure the subject's ability to disembed an item from an organized field of which it is a part. The subject's task on each trial is to locate a previously seen simple figure within a larger complex figure which has been organized so as to obscure or embed the sought-after simple figure. Studies have shown that the ability to keep things separate, as demonstrated by the ability to disembed figures on the EFT, signifies greater differentiation in perceptual functioning and in other areas of the subject's psychological activity.

The simple and complex figures which make up the EFT are modifications of figures selected from those used by Gottschaldt (1926) in his studies of the relative roles of contextual (field) factors and past experience in perception. In Gottschaldt's work, the sought-after simple figure was incorporated into the complex figure, obscured perceptually by means of line patterns. The lack of a sufficient number of line patterns from Gottschaldt's material caused Witkin to develop an additional method of obscuring the simple figures for the EFT by coloring parts of the complex figures so as to reinforce given subwholes, effectively making disembedding more difficult. In the GEFT, to allow for mass reproduction, the function of the colors in the EFT is achieved by light shading of similar sections.

The GEFT was designed for use where large numbers of subjects must be tested for screening on the field-dependence dimension or for carrying out large-scale correlational research in the field of personality. Evidence with respect to reliability and validity make it appear that the GEFT is a satisfactory substitute for the EFT in research requiring group testing.

Format. The GEFT is a 32 page booklet, 5-1/2 inches by 8-1/2 inches, printed in blue ink on white paper. The booklet begins with a series of instructions and two practice exercises with solutions.

On each page the subject is presented with a complex figure and a letter corresponding to the simple figure which is hidden in it. For each problem the subject is instructed to look at the back cover of the booklet to see which simple figure is to be found. The back cover contains drawings of eight simple figures labeled A through H. Once the simple figure is located the subject is instructed to carefully trace it, and then proceed to the next figure. Table 3.2. lists the rules followed by the subject in completing each problem.

Table 3.2. Rules for completing tasks On Group Embedded Figures Test

1.	Look back at the simple forms as often as necessary.
2.	ERASE ALL MISTAKES.
3.	Do the problems in order. Don't skip a problem unless you are absolutely "stuck" on it.
4.	Trace ONLY ONE SIMPLE FORM IN EACH PROBLEM. You may see more than one, but just trace one of them.
5.	The simple form is always present in the complex figure in the SAME SIZE, the SAME PROPORTIONS, and FACING IN THE SAME DIRECTION as it appears on the back cover of this booklet.

Source: Oltman, Raskin & Witkin (1971), p. 3.

The GEFT is divided into three sections: the First Section which contains 7 very simple items and is primarily for practice, and the Second and Third Sections, each of which contains 9 more difficult items. Each section is timed. Two minutes are allowed for the First Section, and five minutes are allowed for each of the Second and Third Sections. Once time expires for a section the subject may not return to it.

Scoring. The score is the total number of simple forms correctly traced in the Second and Third Sections of the test combined. Total scores can range from 0 to 18. Omitted items are scored as incorrect. The items in the First Section are not included in the total score.

A scoring key is provided with the Simple Form traced over each Complex Figure. In order to receive credit for an item, all lines of the Simple Form must be traced. The Scorer must also be sure that no extra lines have been added by the subject and that all incorrect lines have been erased.

Reliability. The 18 items in the Second Section and Third Section of the test are divided into two equivalent forms to permit estimation of reliability coefficients. These forms are matched as closely as possible for item difficulty, discriminative indices and the frequency with which the different simple forms are present in the complex figures. Correlations between the 9-item Second Section scores and 9-item Third Section scores, computed and corrected by the Spearman-Brown prophecy formula, for a normative sample presented by Witkin et al. (1971), had a reliability estimate of .82 for both males and females. In this study the correlation between the Second Section and Third

Section scores calculated using the Spearman-Brown formula was .83.

Many studies have examined odd-even reliabilities (Linton, 1952; Longenecker, 1956; Gardner, Jackson & Messick, 1960) reporting coefficients ranging from .90 to .95 for college students. Bauman (1951) reported a test-retest reliability of .89 after a 3-year interval for college age youth.

Validity. Since the GEFT is intended as a group form of the EFT, the most direct criterion measure is the EFT form of the test. Results reported by Witkin et al. (1971) where subjects were given the Second Section of one form and the Third Section of the other form produced validity coefficients ranging from .63 to .82 for undergraduate college students.

Evidence of convergent and divergent validity for the EFT has been established through a great number of correlational and factor analytic studies with other measurement instruments (Witkin et al., 1971). Their findings indicate that performance on the EFT is related to performance in a variety of other perceptual tests which involve the subject's ability to overcome an embedding context and to perform a variety of intellectual tasks involving the same ability. These studies have also provided evidence that the EFT does not relate highly to performance in tests which do not require disembedding such as with tests of verbal ability.

Other studies have supported the construct validity of the concept that performance on the EFT reflects the subject's level of differentiated functioning in perception which is associated with differentiated functioning in a variety of psychological areas.

Psychological concepts investigated for their relation to the EFT have included: a lesser sense of separate identity in those dominated by organization of the surrounding context (e.g. Linton and Graham, 1959); a lesser differentiated body concept by persons demonstrating a high level of analytical ability (e.g. Witkin et al., 1962); a tendency to use specialized defenses such as intellectualization and isolation by persons with greater analytical ability (e.g. Witkin et al., 1962); among others.

State-Trait Anxiety Inventory

The State-Trait Anxiety Inventory (STAI) is a self-report instrument for measuring state and trait anxiety. The STAI has been used more extensively in psychological research than any other anxiety measure (Buros, 1978).

Construction of the STAI began in 1964 with an initial goal of developing a single set of items that could be administered with different instructions ("how you feel now" versus "how you generally feel") to provide objective measures of state and trait anxiety. However, based on item-validation attempts, Spielberger, Gorsuch and Lushene (1970) developed Form X of the STAI with a revised test-construction strategy of developing separate scales for measuring state anxiety and trait anxiety. In 1980 Spielberger et al. developed Form Y of the STAI which involved replacing some items on Form X with items of equal or better psychometric properties.

Scales. The STAI is composed of two scales. The S-Anxiety (state anxiety) scale evaluates how respondents feel "right now, at this moment." The essential qualities evaluated by the STAI S-Anxiety scale are feelings of apprehension, tension, nervousness, and worry. Scores on the S-Anxiety scale increase in response to physical danger and psychological stress. This scale has been widely used to evaluate how subjects feel at a particular time or in response to a particular situation. In this study the S-Anxiety scale was used to measure subjects' psychological stress response to the training situation.

The T-Anxiety (trait anxiety) scale evaluates how people "generally feel." Widely administered in medical and psychiatric settings, this scale is used for screening individuals with anxiety problems. In experimental research the STAI T-Anxiety scale has proven useful in identifying persons with differing levels of motivation, drive, and neurotic anxiety.

Format. The S-Anxiety scale (STAI Form Y-1) consists of twenty statements that evaluate how subjects feel "right now, at this moment". Statements on the S-Anxiety scale, for example, include "I feel calm" and "I am worried." The T-Anxiety scale (STAI Form Y-2) consists of twenty statements that assess how people "generally feel". Statements on the T-Anxiety scale, for example, include "I feel satisfied with myself" and "I make decisions easily". Subject's respond by indicating their level of agreement to each statement on a four point Likert-type scale with the following descriptors: (1) not at all, (2) somewhat, (3) moderately so, and (4) very much so.

The STAI was designed to be a self-administered instrument that may be given either individually or to groups. There is no time limit for completion of the instrument. Complete instructions for the S-Anxiety and the T-Anxiety scale are printed on the test form. Critical to the validity of the inventory is the subject's clear understanding of the "state" instruction which require them to report how they feel "right now, at this moment", and the "trait" instructions which ask them to indicate how they "generally feel."

The T-Anxiety scale is designed to always be given in the prescribed format with the instructions printed on the test form. The S-Anxiety scale instructions may be modified to evaluate intensity of S-Anxiety for a specific situation. In this study the instructions were modified to instruct subjects to indicate how they feel "right now, as a result of this training experience", with the S-Anxiety scale being administered immediately at the conclusion of training.

Scoring. Each STAI item is given a weighted score of 1 to 4. A rating of 4 indicates the presence of a high level of anxiety for ten S-Anxiety items and eleven T-Anxiety items (e.g. "I fell frightened,""I feel upset"). A high rating for the remaining ten S-Anxiety items and nine T-Anxiety items indicates the absence of anxiety (e.g., "I feel calm,""I feel relaxed"). The scoring weights for the anxiety-absent items are reversed, i.e. responses marked 1,2,3, or 4 are scored 4,3,2, or 1, respectively.

To obtain scores for the S-Anxiety and T-Anxiety scales the weighted scores for the twenty items that make up each scale are summed, taking into account the reversed scores as noted above. Scores for both the S-Anxiety and the T-Anxiety scales can vary from a minimum of 20 to a maximum of 80.

Reliability. Stability, as measured by test-retest coefficients, is relatively high for the STAI T-Anxiety scale. Test-retest correlations reported by Spielberger (1983) ranged from .73 to .86 for college students where intervals between tests ranged from 1 hour to 104 days. The median reliability coefficient for the T-Anxiety scale for college students was .765. As would be expected, test-retest coefficients for the STAI S-Anxiety scale were low (median reliability coefficient of .33) because this scale is expected to change in response to situational stress.

The internal consistency for both the S-Anxiety and T-Anxiety scales is quite high as measured by alpha coefficients. Overall median alpha coefficients for the Form Y S-Anxiety and T-Anxiety scales in Spielberger's (1983) normative samples were .92 and .90 respectively. In this study internal consistency as measured by Cronbach's alpha coefficients were found to be .88 and .87 for the S-Anxiety and T-Anxiety scales respectively.

Validity. Evidence of construct validity for the STAI has been established through contrasted group studies (Spielberger, 1983). Studies comparing mean scores of neuropsychiatric patient (NP) groups with normal subjects on the T-Anxiety scale have shown that the NP groups have substantially higher T-Anxiety scores than normal subjects, providing evidence that the STAI discriminates between normals and psychiatric patients for whom anxiety is a major symptom. The scores of military recruits tested shortly after they began highly stressful training programs were much higher on the S-Anxiety scale than those of college and high school students of about the same age who were tested under relatively nonstressful conditions. The mean S-Anxiety scores for the recruits were much higher than their own T-Anxiety scores, suggesting that these subjects were experiencing a high state of emotional turmoil when they were tested. In contrast the mean S-Anxiety and T-Anxiety scores for normal subjects tested under relatively nonstressful conditions were quite similar.

Evidence of concurrent validity of the T-Anxiety scale has been established by correlation studies with other generally accepted anxiety measures including the IPAT Anxiety Scale (Cattell & Scheier, 1963) and the Taylor Manifest Anxiety Scale (TMAS) (Taylor, 1953). The IPAT Anxiety Scale and the TMAS were the most widely used measures of trait anxiety at the time STAI Form X was being developed (Spielberger et al., 1970). Correlations between the T-Anxiety scale, the IPAT, and the TMAS were relatively high across several test populations, ranging from .85 to .73.

Correlation studies between the STAI and personality tests have been conducted to establish the convergent and divergent validity of the instrument. A correlation of .70 for both the T-Anxiety and S-Anxiety scales with the Cornell Medical Index indicates that a large number of medical symptoms are associated with high STAI scores. The absence of a relationship between the STAI scales and the U.S. Army Beta intelligence test is consistent with findings that the STAI is essentially unrelated to measures of intelligence or scholastic aptitude. The T-Anxiety scale correlated significantly with each problem area identified on the Mooney Problem Checklist, College Form (Mooney & Gordon, 1950) suggesting that anxiety-prone college students develop problems in almost every area of adjustment. Correlations between the STAI and measures of academic aptitude and achievement show that the STAI scales are essentially unrelated to aptitude and achievement for college students.

Demographic Questionnaire

In addition to the GEFT and STAI, subjects also completed a brief questionnaire (see Appendix B). The questionnaire was design to determine the subject's prior experience with computers, and also their age and sex.

Subjects

Subjects participating in the study were 72 undergraduate students enrolled in one or more of three different courses in the Hotel, Restaurant and Tourism Management (HRTM) Program at Oregon State University. The age of the subjects ranged from 18 to 43 with a median age of 22. Table 3.2 the age, sex, and prior computer experience level of the subjects in this study.

Table 3.3 Age, sex and prior computer experience level of subjects.

Sex:	Males		Females	
	27		45	
Age:	Years	Number	Years	Number
	17-18	10	29-30	1
	19-20	30	...	
	21-22	18	37-38	1
	23-24	4	...	
	25-26	5	41-42	1
	27-28	1	43-44	1

Prior Computer Experience: Level	Number
Illiterate	10
Hacker	11
Average	40
Computer Literate	9
Expert	2

Data Collection Procedure

The following steps were followed in collecting data for this study. Figure 3.1 diagrams the research process.

1. During classes in April of 1987, six weeks prior to the training session, subjects were administered the Group-Embedded Figures Test, the T-Anxiety scale of the State-Trait Anxiety Inventory, and the demographic questionnaire. Students who asked the purpose of the instruments following their administration were told that results were being used to assist in improving teaching methods within the HRTM program.
2. One week prior to the training session, subjects were requested to sign up for one of twelve training times with space for six

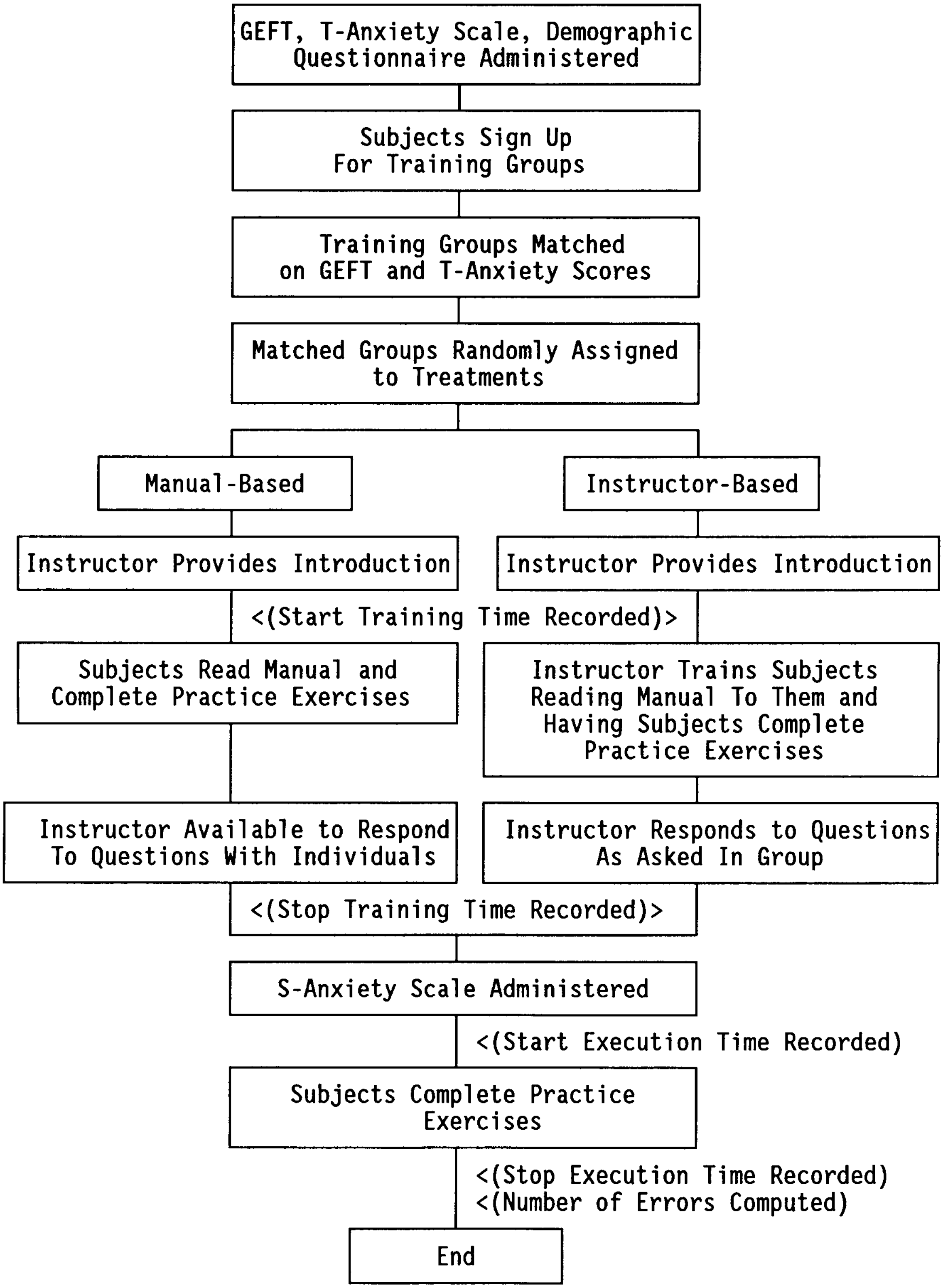

Figure 3.1 Flow Diagram of Experiment

students in each session. (Due to a subject scheduling conflict one group had seven subjects and one group had five subjects.) Subjects were told they were being asked to assist in testing a new computerized beverage management system for understandability and ease of use.

3. Average scores were calculated for each group of six students on the GEFT and T-Anxiety scales of the STAI. Scores between groups were compared and groups with similar scores were paired. One group from each pair was randomly assigned by coin toss to receive the IBT treatment and the other to receive the MBT treatment.
4. At the designated time subjects arrived at the computer lab. Each was assigned a Leading Edge personal computer (IBM compatible) at which to work. Subjects were issued two floppy disks, a program disk and a data disk. Subjects in the MBT group also received the training manual and were told not to open it until instructed to do so.
5. For both groups the instructor provided subjects with a verbal overview of what was to happen during the training session following the outline presented in Appendix C.
6. Subjects were trained to operate MBMS. Only one group was trained at a given time. Under both treatments subjects were instructed to turn on their computers at the same point early in training at which time the computer automatically recorded the starting time of the training period. At the completion of training when subjects were instructed to exit the system, the computer automatically recorded the ending time of the training period.

Manual-based. Subjects were instructed to open the manual and proceed at their own pace through the material and practice problems. The instructor remained in the room during training and responded individually to subjects who had questions or difficulty.

Instructor-based. The instructor presented the training material by reading from the manual. Subjects learning by IBT received substantially the same information, and completed the exact same practice exercises as did subjects learning by MBT. The instructor attempted to duplicate the content of the training presented in the manual as closely as possible. The instructor responded immediately to subject's questions, responding so that all subjects in the lab could hear the answer.

7. Upon completion of the training session the computer administered the S-Anxiety scale of the STAI. As subjects were completing the S-Anxiety scale the instructor placed a copy of the representative tasks along side each work station (presented in Appendix D).
8. Upon completion of the S-Anxiety scale the computer returned to the MBMS system and subjects were instructed to complete the representative tasks. The computer automatically recorded the start time of the execution period for completing the representative tasks. The representative tasks consisted of entering the delivery of 15 items into inventory, changing the purchase price of four items, recording usage of 27 items, and changing the prices on two categories of drinks.

9. Upon completion of the representative tasks the computer recorded the ending time of the execution period, and displayed a message thanking subjects for participating and instructing them to turn off the machine and return all materials to the instructor.
10. The computer recorded the information entered while completing the representative tasks (see Appendix E). The information entered was scored with an error being either entry of a wrong number, or recording a number for the wrong item. Items that were entered incorrectly initially, but corrected before leaving the system were not counted as errors.

Hypotheses of the Study

The hypotheses tested in this study are presented in three groups. The first group is concerned with the relationship between measures of performance and learner characteristics. The second group is concerned with differences in performance due to instructional delivery method received. The third group is concerned with determining if individual differences in learner characteristics partially explain differences in performance due to instructional delivery method.

Relationships Between Learner Characteristics and Performance

$H_0 1$: There is no correlation between a subject's performance and the subject's level of field dependence.

$H_0 2$: There is no correlation between a subject's performance and the subject's level of trait anxiety.

$H_0 3$: There is no correlation between a subject's performance and the subject's level of state anxiety.

$H_0 4$: There is no correlation between a subject's performance and a subject's age.

$H_0 5$: There is no difference in performance between subject's grouped by level of prior computer experience.

$H_0 6$: There is no difference in performance between male and female subjects.

Differences In Performance Due to Instructional Delivery Method

$H_0 7$: There is no difference in performance between subjects trained using manual-based training (MBT) and subjects trained using instructor-based training (IBT).

Relationships Between Learner Characteristics and Performance Controlling for Instructional Delivery Method

$H_0 8$: There is no difference in significance between the correlation of performance with level of field dependence using MBT and the correlation of performance with level of field dependence using IBT.

$H_0$9: There is no difference in significance between the correlation of performance with level of trait anxiety using MBT and the correlation of performance with level of trait anxiety using IBT.

$H_0$10: There is no difference in significance between the correlation of performance with level of state anxiety using MBT and the correlation of performance with level of state anxiety using IBT.

$H_0$11: There is no difference in significance between the correlation of performance with age using MBT and the correlation of performance with age using IBT.

$H_0$12: There are no differences in performance means between subjects grouped by level of prior computer experience and by instructional delivery method.

$H_0$13: There are no differences in performance means between subjects grouped by sex and by instructional delivery method.

Statistical Treatment of the Data

Statistical analysis for this research was performed on a personal computer using Statgraphics statistical software package.

Statistical tests for difference between mean performance measures were conducted using t-tests and oneway analysis of variance (ANOVA). Null hypotheses of no difference were rejected when the significance level of the t statistic or F ratio was less than 0.05. Tests for correlation between independent variables and dependent variables were performed using Pearson's product-moment correlation analysis (r). Null hypotheses of no correlation were rejected when the significance level of the F statistic was less that 0.05.

Tests for differences and interactions between independent variables and dependent variables controlling for treatment were performed using multifactor ANOVA with a 2x2 or 2x3 design. Null hypotheses of no differences or interactions between group means were rejected when the significance level of the F statistic was less than 0.05.

CHAPTER 4

PRESENTATION OF FINDINGS

The main objectives of this study were: to determine if individual differences in the learner characteristics of field dependence, state and trait anxiety, age, sex, and prior computer experience were related to performance in operating a computer software system; to determine if differences in performance would occur as a result of two different instructional delivery methods, manual-based training and instructor-based training; and to determine if differences in performance between instructional delivery methods could be partially explained by differences in the learner characteristics examined.

The results of this study are presented in three sections. The first section presents descriptive statistics for the dependent variables (measures of performance) and independent variables (learner characteristics) in the study. The second section presents the hypotheses tested. Each hypothesis is specified, followed by a presentation of the data, a rationale for accepting or rejecting the hypothesis, and a discussion of the findings. In all analyses a probability level of .05 is required for significance. The third section provides a summary of the findings.

Summary of Variables

This study investigated the relationships between six learner characteristics and three measures of performance in operating a computer system.

Measures of Performance

For this study the dependent variable was defined as performance in learning and using a computer software system. Based on prior research reviewed in the literature, three measures of performance were selected for use in this study: (1) training time, time required to complete training; (2) execution time, time required to complete a series of representative tasks following training; and (3) execution errors, number of errors remaining upon completion of representative tasks. Table 4.1 presents the means, standard deviations, and ranges for each of these variables.

Table 4.1 Descriptive statistics for measures of performance.

Variable	Mean	Std Dev	Minimum	Maximum	n
Training Time (minutes)	13.01	2.10	8.07	19.52	72
Execution Time (minutes)	13.04	2.44	6.48	18.60	72
Execution Errors (count)	2.71	8.92	0	55	72

Table 4.2 presents the coefficients of correlation between the three measures of performance. All three measures were uncorrelated with each other ($p>.10$) which would imply that each is a distinct measure of performance.

Table 4.2 Pearson product-moment correlations among measures of performance.

	2	3
1. Training Time	-.10	.05
2. Execution Time		-.06
3. Execution Errors		

n=72

Learner Characteristics

Six learner characteristics were included in this study. The six variables were: score on GEFT, score on T-Anxiety Scale, score on S-Anxiety Scale, ranking of prior computer experience, age, and sex. Table 4.3 provides a summary of the values of these variables.

Table 4.3 Descriptive statistics of learner characteristics.

Variable	Mean	Std Dev	Minimum	Maximum	n
GEFT Score	12.33	4.44	2	18	72
T-Anxiety Scale	35.22	6.61	24	54	72
S-Anxiety Scale	28.79	7.29	20	53	72
Age	21.53	4.69	17	43	72

Variable	n	Variable	n
Computer Experience Level:		Sex:	
1 - Illiterate	10	1 - Male	27
2 - Hacker	11	2 - Female	45
3 - Average	40		
4 - Literate	9		
5 - Expert	2		

Due to the limited number of subjects in the upper categories of computer experience, the scale was reduced to three categories with the categories of Illiterate and Hacker combined into a category named Below Average (n=21) and the categories of Literate and Expert combined into a category named Above Average (n=11).

To determine the validity of this ordinal measure of computer experience, subjects were asked eleven questions related to prior computer experience (presented in Appendix B). Subjects were asked if they had prior computer experience: in high school, taking a college course on computers, formal training other than in school; using computers for word processing, spreadsheet analysis, database management; in writing programs in BASIC, in FORTRAN; in preparing assignments at school; or as part of a paying job. Table 4.4 presents the chi-square statistics testing for relationships between the responses to each of these questions and the overall ranking of prior computer experience on the revised three-category scale.

Table 4.4 Chi-square statistics for relationship between overall ranking of prior computer experience and questions related to prior experience.

Computer Experience:	Chi-square
In Highschool	17.53***
College Computer Course	3.45
Used in Other College Courses	1.20
Other Formal Training	14.73***
Word Processing	36.12***
Spreadsheets	9.99**
Database Management	17.26***
BASIC Programming	6.65*
FORTRAN Programming	4.60
Routine Use Now	16.88***
On the Job	5.89

*p<.05 **p<.01 ***p<.001 n=72

Seven of the eleven questions were significantly related to the overall ranking of computer experience. Further examination of the data explained why two of the questions failed to relate to the overall rating scale. The question on experience with FORTRAN programming failed to relate significantly because only four subjects had such experience. Conversely, the question about having taken a college course on computers failed to correlate significantly because almost all subjects, 55 of 72, had taken such a course. Questions related to being required to use a computer either in class or on the job failed to significantly relate to the experience ranking. The significant relationships of the remaining questions to the overall ranking of experience strongly support its validity as an overall measure of prior computer experience.

Correlations between the six learner characteristics measured in the study are given in Table 4.5.

Table 4.5 Pearson product-moment correlations among six learner characteristics.

	2	3	4	5	6
1. Embedded Figures	.05	-.07	-.02	-.08	-.08
2. Trait Anxiety		.36**	-.27*	.01	.08
3. State Anxiety			-.04	-.27*	-.10
4. Age				-.07	-.15
5. Prior Experience					-.08
6. Sex					

*p<.05 **p<.01 n=72

As would be expected from theory, scores for trait anxiety and state anxiety were significantly correlated ($r=.36$, $p<.01$). Individuals exhibiting high levels of state anxiety would be expected to also exhibit high levels of trait anxiety (but not necessarily the reverse). Another significant correlation occurred between age and trait anxiety ($r=-.27$, $p<.05$), indicating that older subjects, on average, exhibited lower levels of trait anxiety. The third significant correlation was a negative relation between state anxiety and prior computer experience ($r=-.27$, $p<.05$) indicating that subjects with prior experience were less disposed to experience state anxiety during the learning experience. With the exception of these three specific cases, the six selected variables captured rather distinct learner characteristics as shown by their low correlations with each other.

Tests of Hypotheses

The hypotheses tested in this study are presented in three groups. The first group is concerned with the relationship between measures of performance and learner characteristics. The second group is concerned with differences in performance due to instructional delivery method received. The third group is concerned with determining if individual differences in learner characteristics partially explain differences in performance due to instructional delivery method.

Relationships Between Learner Characteristics and Performance

The first six hypotheses of this study are concerned with testing the correlation between each of the six learner characteristics examined and the measures of performance.

$H_0 1$: There is no correlation between a subject's performance and the subject's level of field dependence.

To test this hypothesis Pearson product-moment correlations (r) were calculated between the GEFT scores and each of the three measures of performance: training time, execution time and execution errors. The results are presented in Table 4.6.

Table 4.6. Pearson product-moment correlations between measures of performance and level of field dependence.

Comparison	r	Significance
GEFT Score with:		
Training Time	-.12	ns
Execution Time	-.28	$p<.01$
Execution Errors	.03	ns

n=72

For the performance measures of training time and execution errors the observed correlation coefficients were too small and the significance levels too large to allow us to reject the null hypothesis of no relation between performance and level of field dependence. However, for the performance measure of execution time a correlation coefficient of -0.28 at a one-tailed significance level of $p<.01$ allows us to reject the null hypothesis and accept the alternative hypothesis that there is a negative correlation between GEFT scores and the execution time measure of performance. The higher the score on the

GEFT (representing a greater ability to disembed figures from the complex field, a greater degree of field independence), the shorter the time in performing the representative tasks using the computer system.

Discussion. The ability of field-independent subjects to perform significantly faster than field-dependent subjects could be explained by: (1) a superior ability of field-independent subjects to locate and utilize necessary instructions, either through more effective cognitive strategies for coding and storing instructions in memory, or through a superior ability to efficiently refer back to the manual; (2) organization or wording of information on the computer screen which favors field-independent subjects, a format which permits them to easily focus on relevant items; or (3) training content and organization which favors learning by field-independent subjects. Further research comparing strategies used by field-dependent and field-independent learners in completing tasks, testing for effectiveness of alternative wording and presentation of information on the computer screen, and comparing results using different organization and content of training would assist in evaluating these alternative explanations for the significant correlation identified in this study.

$H_0 2$: There is no correlation between a subject's performance and the subject's level of trait anxiety.

To test this hypothesis Pearson product-moment correlations (r) were calculated between the T-Anxiety scale scores and each of the three measures of performance. The results are presented in Table 4.7.

Table 4.7 Pearson product-moment correlations between measures of performance and trait anxiety.

Comparison	r	Significance
T-Anxiety Scale score with:		
Training Time	-.11	ns
Execution Time	.06	ns
Execution Errors	-.05	ns

n=72

For all three performance measures the correlation coefficients were small and the significance levels were large such that we fail to reject the null hypothesis of no correlation between performance and trait anxiety. The level of trait anxiety does not appear to be related to the performance of subjects in learning and using the computer software system.

Discussion. While no significant relationship was found between trait anxiety and performance, such a result may be due to the homogeneity of the test population with respect to this variable. Normative groups used in test construction (Spielberger, 1983) reported means for college students slightly higher than our sample (males 38.30, females 40.40, this study 35.22 combined). More significant, however, was a noted difference in standard deviations. The normative population showed a much greater variance than was found in the test population (males 9.18, females 10.15, this study only 6.61 combined). The reduced variance in the test population on this variable may have diminished its ability to detect significant differences. Replication of the study with a test population exhibiting a more typical distribution of T-Anxiety scores may result in a different conclusion.

$H_0$3: There is no correlation between a subject's performance and the subject's level of state anxiety.

To test this hypothesis Pearson product-moment correlations (r) were calculated between the S-Anxiety scale score for each subject and each of the three measures of performance. The results are presented in Table 4.8.

Table 4.8 Pearson product-moment correlations between measures of performance and state anxiety.

Comparison	r	Significance
S-Anxiety Scale score with:		
Training Time	.06	ns
Execution Time	.06	ns
Execution Errors	-.05	ns

n=72

For all three performance measures the correlation coefficients were near zero and the significance levels were large such that we fail to reject the null hypothesis of no correlation between performance and state anxiety. The level of state anxiety does not appear to be related to the performance of subjects in learning and using the computer system.

<u>Discussion</u>. Again, the test population was more homogeneous than would be expected. Normative groups used in test construction (Spielberger, 1983) reported means for college students higher than our sample (male 36.47, females 38.76, this study 28.79 combined). Also evident was the difference in standard deviations with the normative population showing much greater variance (males 10.02, females 11.95,

this study 7.29 combined). Given a population with a more typical distribution of S-Anxiety scores, differences may be detected.

$H_0$4: There is no correlation between a subject's performance and a subject's age.

To test this hypothesis Pearson product-moment correlations (r) were calculated between the age of each subject and each of the three measures of performance. The results are presented in Table 4.9.

Table 4.9 Pearson product-moment correlations between measures of performance and age.

Comparison	r	Significance
Age with:		
Training Time	.20	ns
Execution Time	.07	ns
Execution Errors	-.04	ns

n=72

For all three performance measures the correlation coefficients were small and the significance levels were large such that we fail to reject the null hypothesis of no correlation between performance and age. The age of the subject in this study does not appear to be related to the performance of the subject in learning and using the computer software system.

Discussion. While prior research on computer users has found differences in performance due to age, it is not clear if such differences in performance were due to the physiological changes that occur with age, or to cohort differences (a cohort being a group of people born in the same time interval). Cohort differences would be expected due to the differences in age at which people were introduced to computers. Younger cohorts have been born and raised with computers as commonplace, while older cohorts have had to adopt, adapt to, and often resist this technology. Such differences would be expected to produce differences in performance.

While there were older students in the test population, their prior computer experience was not atypical of the total sample. Therefore, the test population could not be considered representative of more than one cohort. The finding of no relation of age to performance would suggest that prior significant findings reported in the literature may actually be measuring cohort differences and not differences due to the physiological effects of aging. Further research drawing from populations representing both different cohorts and different age groups would be necessary to determine what impact these two dimensions of age have on performance, if any.

> $H_0 5$: There is no difference in performance between subjects grouped by level of prior computer experience.

To test this hypothesis a oneway analysis of variance (ANOVA) was conducted for each of the three measures of performance. Table 4.10 presents the results of the analysis for training time.

Table 4.10 Analysis of variance between training time measure of performance and levels of prior computer experience.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	2	1.438	.719	.16	.854
Within Groups	69	312.772	4.533		
Total	71	314.209			

Skill Level	Count	Mean	95 Percent Confidence Intervals for Mean	
Below Avg	21	13.178	12.251	14.105
Average	40	13.003	12.331	13.674
Above Avg	11	12.733	11.452	14.014
Total	72	13.012	12.512	13.513

Based upon the very low F ratio (.16) and the high significance level (.854) we fail to reject the null hypothesis of no difference in mean training times between subjects grouped by level of prior computer experience. While the mean training time for each group decreased with experience, the associated variances and resulting confidence intervals of those means were large, prohibiting us from concluding with any confidence that training time decreases with prior experience.

Table 4.11 presents the oneway analysis of variance comparing the performance measure of execution time with ranking of prior computer experience.

Table 4.11 Analysis of variance between execution time measure of performance and levels of prior computer experience.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	2	3.306	1.653	.27	.763
Within Groups	69	419.675	6.082		
Total	71	422.979			

Skill Level	Count	Mean	95 Percent Confidence Intervals for Mean	
Below Avg	21	12.964	11.890	14.038
Average	40	13.195	12.417	13.973
Above Avg	11	12.590	11.106	14.074
Total	72	13.035	12.455	13.615

Based upon the low F ratio (.27) and the high significance level (.763) we fail to reject the null hypothesis of no difference in execution time between subjects grouped by level of prior computer experience. Inspection of the confidence intervals for the mean shows that the time required to perform the representative tasks using the computer system was very similar for all three groups, indicating that prior experience has little impact on time required to operate this computer software system.

Table 4.12 presents the oneway analysis of variance comparing the performance measure of execution time with ranking of prior computer experience.

Table 4.12 Analysis of variance between execution errors measure of performance and levels of prior computer experience.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	2	57.068	28.535	.35	.705
Within Groups	69	5593.806	81.079		
Total	71	5650.875			

Skill Level	Count	Mean	95 Percent Confidence Intervals for Mean	
Below Avg	21	3.286	-.635	7.206
Average	40	2.975	.134	5.815
Above Avg	11	.636	-4.781	6.053
Total	72	2.708	.591	4.826

Again, based upon the low F ratio (.35) and the high significance level (.705) we fail to reject the null hypothesis of no difference in number of execution errors made by subjects grouped by level of prior computer experience. While the mean number of errors for each group decreased with experience, the associated variances and resulting confidence intervals of those means were large, prohibiting us from concluding with any confidence that number of errors decrease with prior experience.

Discussion. The finding of no significant difference in performance due to prior experience would indicate that either the task was so simple and unique that individuals with prior experience had no advantage, or that the training was effective such that any advantage was diminished through effective instructional methods. Prior computer experience in this study, given the relatively simple nature of the task, did not significantly impact performance.

$H_0 6$: There is no difference in performance between male and female subjects.

To test this hypothesis, t-tests were conducted comparing the mean performance measures between men and women. Table 4.13 presents the t-test results comparing differences in training time.

Table 4.13 T-test of mean training time between males and females.

Sex	Number of Cases	Mean	Standard Deviation	Standard Error
Male	27	13.150	2.247	.432
Female	45	12.930	2.034	.303

Equality of Variance		Pooled Variance Estimate		
F Value	2-Tail Probability	t Value	Degrees of Freedom	2-Tail Probability
1.22	.549	.43	70.0	.671

For the first of the three performance measures, based on the results of the t-test (t=.43, p>.10), we fail to reject the null hypothesis of no difference in mean training time between males and females. In this study there appears to be no significant difference in training time due to sex.

Table 4.14 presents the t-test comparing execution time between males and females.

Table 4.14 T-test of mean execution time between males and females.

Sex	Number of Cases	Mean	Standard Deviation	Standard Error
Male	27	13.561	2.622	.505
Female	45	12.719	2.297	.342

Equality of Variance		Pooled Variance Estimate		
F Value	2-Tail Probability	t Value	Degrees of Freedom	2-Tail Probability
1.30	.430	1.43	70.0	.158

Based on the results of the t-test (t=1.43, p>.10), we fail to reject the null hypothesis of no difference in mean execution time between males and females. In this study there appears to be no significant difference in execution time due to sex.

Table 4.14 presents the t-test comparing number of execution errors made between males and females.

Table 4.15 T-test of mean execution errors between males and females.

Sex	Number of Cases	Mean	Standard Deviation	Standard Error
Male	27	4.407	11.527	2.218
Female	45	1.689	6.862	1.023

Equality of Variance		Separate Variance Estimate		
F Value	2-Tail Probability	t Value	Degrees of Freedom	2-Tail Probability
2.82	.002	1.11	37.24	.273

The two samples have significantly difference variances as demonstrated by the F-test for equality of variances ($F=2.82$, $p<.01$), therefore it is necessary to utilize the separate variance estimate in calculating the t-value. The calculated value ($t=1.11$, $p>.10$) shows the mean number of execution errors made by males and females to not be significantly different, that is, we fail to reject the null hypothesis of no difference in number of mean performance errors. Therefore, on all three measures of performance, there appears to be no significant difference between males and females in this study.

Discussion. Training and execution times for women were slightly faster than for men (with smaller standard deviations) providing weak evidence that an age difference may exist, however, in this study such findings were not found to be significant. Prior research which argues and finds that women have been disadvantaged with respect to being trained to use computers is not supported in this study.

Differences In Performance Due to Instructional Delivery Method

$H_0 7$: There is no difference in performance between subjects trained using manual-based training (MBT) and subjects trained using instructor-based training (IBT).

To test this hypothesis t-tests were performed comparing the mean performance measures of the IBT experimental group with the mean performance measures of the MBT control group. The first test was a comparison of the mean training time measures of performance. The results are presented in Table 4.16.

Table 4.16 T-Test of mean training times by instructional delivery method.

Instructional Method	Number of Cases	Mean	Standard Deviation	Standard Error
MBT	35	12.361	2.706	.457
IBT	37	13.627	1.006	.165

Equality of Variance		Separate Variance Estimate		
F Value	2-Tail Probability	t Value	Degrees of Freedom	2-Tail Probability
7.23	.000	-2.60	42.79	.013

The mean time required for training using IBT is significantly greater than the mean time required for training using MBT. The difference is 1.27 minutes or approximately 10 percent longer for IBT, on average, than for MBT.

Using MBT, subjects control the time required for training. Using IBT, to a great extent, the instructor controls the time required for training. Therefore we expect the two samples to have different variances which is the case as demonstrated by the F-test for equality of variances ($F=7.23$, $p<.001$). To account for the difference in variance in determining the significance level of the difference between means it is necessary to utilize the separate variance estimate in calculating the t-value. The calculated value ($t=-2.60$, $p<.05$) shows the mean training time between the two delivery methods to be significantly different. Therefore, with respect to the training time measure of performance, we reject the null hypothesis of no difference in performance between IBT and MBT, and accept the alternate hypothesis that mean training time for IBT is greater than mean training time for MBT.

The second test was a comparison of the mean execution time measure of performance. The results are presented in Table 4.17.

Table 4.17 T-test of mean execution time by instructional delivery method.

Instructional Method	Number of Cases	Mean	Standard Deviation	Standard Error
MBT	35	13.771	2.500	.423
IBT	37	12.338	2.196	.361

		Pooled Variance Estimate		
F Value	2-Tail Probability	t Value	Degrees of Freedom	2-Tail Probability
1.30	.444	2.59	70	.012

The mean execution time for subjects trained using IBT was 1.44 minutes shorter, or approximately 10 percent shorter than for students trained using MBT. This difference was found to be statistically significant ($t=2.59$, $p<.05$). Therefore, with respect to execution time, we reject the null hypothesis of no difference and accept the alternative hypothesis that execution time on the representative tasks is significantly shorter for subjects trained using IBT than it is for subjects trained using MBT.

A third t-test for difference in means was conducted comparing the mean number of execution errors made by the IBT group versus the MBT group. The results are presented in Table 4.18.

Table 4.18 T-test of mean execution errors by instructional delivery method.

Instructional Method	Number of Cases	Mean	Standard Deviation	Standard Error
MBT	35	2.200	7.783	1.316
IBT	37	3.189	9.963	1.638

Equality of Variance		Pooled Variance Estimate		
F Value	2-Tail Probability	t Value	Degrees of Freedom	2-Tail Probability
1.64	.151	-0.47	70	.641

While, on average, subjects trained using IBT made more errors than subjects trained using MBT, that difference was not found to be statistically significant (t=-.47, p>.10). The variance was very large for both groups indicating that training method has little impact upon number of errors made. Therefore, with respect to execution errors, we fail to reject the null hypothesis of no difference in mean number of execution errors made between subjects trained using MBT and subjects trained using IBT.

Discussion. Training time for MBT, on average, was significantly shorter than training time for IBT. Conversely, execution time on the representative tasks for IBT was significantly faster than for MBT. Observations made during the experiment can partially explain these results.

Subjects learning by MBT typically proceeded at a rapid pace through the training material, completing the practice exercises in a step-by-step fashion without apparent consideration for the significance or content of the activities. When MBT subjects completed training and performed the representative tasks, many were observed referring back to the training material, indicating that the training had not been sufficient to complete the task without further assistance. Time spent referring back to the training materials, along with the division of attention between those materials and the computer could partially explained the longer execution time for this group.

Training during IBT proceeded closest to the speed of the slowest learner in the group. Students who learned faster often had to wait for the slowest subject to finish each step before the instructor proceeded. IBT, through instructor observation, insured that subjects had completed the required practice problems in each section, and were provided the opportunity to ask questions about functions or concepts they did not understand. During the execution phase IBT students appeared to perform faster because they did not spend time referring back to training materials (as they did not have any), tended to focus their full attention on the computer screen and its instructions, and appeared to have greater recall of the content of the practice problems from training and how those exercises related to the new problem set.

For the test population in this study, on average, IBT took longer but was more effective than MBT in preparing subjects to perform the representative tasks. Under IBT, students had no alterative but to learn necessary skills during the training phase. Under MBT, students, knowing they would be able to go back to training materials, may not have been as thorough in learning skills during training.

Relationships Between Learner Characteristics and Performance Controlling for Instructional Delivery Method

$H_0 8$: There is no difference in significance between the correlation of performance with level of field dependence using MBT and the correlation of performance with level of field dependence using IBT.

To test this hypothesis, Pearson product-moment correlations (r) were calculated to measure the relationship between the level of field dependence and the three measures of performance for subjects in each treatment group, manual-based training and instructor-based training. Table 4.19 presents the coefficients of correlation.

Table 4.19 Pearson product-moment correlations between measures of performance and scores on GEFT by instructional delivery method.

Comparisons:	MBT n=35 r	IBT n=37 r
GEFT Score with:		
Training Time	-.10	-.29
Execution Time	-.34*	-.22
Execution Errors	.01	.04

*p<.05

For the performance measures of training time and number of execution errors observed with MBT and IBT, the observed correlation coefficients were small and the significance levels were large ($p>.05$) such that we fail to reject the null hypothesis of no correlation.

Therefore, with respect to training time and execution errors, we conclude that there is no difference in performance between MBT and IBT.

For the performance measure of execution time, subjects in the MBT treatment group showed a statistically significant correlation ($r=-.34$, $p<.05$) between execution time and GEFT scores, allowing us to reject the null hypothesis of no correlation. Subjects in the IBT treatment group did not demonstrate a statistically significant correlation ($r=-.22$, $p>.10$).

From these findings we conclude that using MBT, there is a statistically significant negative correlation between GEFT scores and the execution time measure of performance. The higher the score on the GEFT (representing a greater ability to disembed figures from the complex field, a greater degree of field independence), the shorter the time in performing the representative tasks using the computer system.

Discussion. Prior research presented in the literature review chapter found that field-independent individuals perform better on learning and memory tasks. Such results where hypothesized to be due to field-independent individuals being inclined to take a more active approach to learning, where field-dependent subjects adopt a more passive, spectator approach. Using MBT, subjects need to assume much of the responsibility for completing and insuring understanding of the material presented, success at which would require an active approach to learning. IBT places much of the responsibility for learning on the instructor, thus IBT should facilitate both active and passive approaches to learning. Results of this study would support such a hypothesis related to active and passive approaches to learning by field-independent and field-dependent learners respectively.

Prior research reviewed also reported that relatively field-dependent persons are likely to favor educational-vocational domains that feature social content and that require interpersonal relations. It is hypothesized that field-dependent learners would favor IBT due to its interpersonal aspects of communication between instructor and subject, and the opportunity for human response to questions and concerns. Field-independent persons are likely to favor domains in which social content and relations with people are not especially involved but for which analytical skills are important. It is hypothesized that field-independent learners would favor MBT due to its lack of dependence on interpersonal interaction. Such hypotheses are partially supported by the results of this study.

Based on the findings, MBT appears more effective for training field-independent subjects than it does for field-dependent subjects. IBT appears to mediate differences between field-dependent and field-independent subjects such that the observed correlations between performance measures and level of field-dependence are not as strong using IBT. Further research needs to be conducted to determine specifically if prescribing MBT for field-independent subjects and IBT for field-dependent subjects would result in the greatest level of training effectiveness.

$H_0 9$: There is no difference in significance between the correlation of performance with level of trait anxiety using MBT and the correlation of performance with level of trait anxiety using IBT.

To test this hypothesis, Pearson product-moment correlations (r) were calculated for subjects in each treatment group, manual-based training and instructor-based training, to measure the relationship between the level of trait anxiety and the three measures of performance. Table 4.20 presents the coefficients of correlation.

Table 4.20 Pearson product-moment correlations between measures of performance and scores on T-Anxiety Scale by instructional delivery method.

Comparisons:	MBT n=35 r	IBT n=37 r
T-Anxiety Score with:		
Training Time	-.08	-.20
Execution Time	-.15	.28
Execution Errors	-.05	-.05

For all three measures of performance under both instructional delivery methods, correlations with trait anxiety scores were low and significance levels high ($p>.05$) such that we fail to reject the null hypothesis of no correlation in all cases.

A major difference between methods can be noted with the performance measure of execution time. Under MBT the correlation is negative ($r=-.15$) indicating that individuals with lower levels of trait anxiety actually took longer to complete the representative problems than did subjects with higher levels of trait anxiety. Subjects receiving IBT showed a positive correlation (r=.28), indicating that subjects with lower trait anxiety performed the representative problems faster than did subjects with higher state anxiety. By categorizing subjects' trait anxiety as high or low based on a ranking of their T-Anxiety scale score, a 2x2 multifactor analysis of variance was performed testing differences in means between levels of trait anxiety and instructional delivery method received. Table 4.21 presents the results of that analysis.

Table 4.21 Multifactor analysis of variance of mean execution time by trait anxiety group and instructional delivery method received.

Source of Variation	Sum of Squares	D.F.	Mean Square	F Ratio	F Sig.
Main Effects	40.214	2	20.107	3.80	.027
Delivery Method	34.067	1	34.067	6.44	.014
Trait Anxiety	3.277	1	3.277	.62	.442
2 Factor Interaction	22.913	1	22.913	4.33	.041
Residual	359.853	58	5.292		
Total	422.979	71			

Delivery Method	Trait Anxiety	Count	Mean	95 Percent Confidence Interval of Mean	
MBT	Low	15	14.198	12.995	14.548
MBT	High	20	13.452	12.425	14.478
IBT	Low	20	11.637	10.610	12.664
IBT	High	17	13.164	12.050	14.277
Total		72	13.035	12.494	13.576

While the main effect of trait anxiety is not significant (F=.62, p>.10), the interaction effect between instructional delivery method and level of trait anxiety is statistically significant ($F=4.33$, $p<.05$). Therefore we conclude that the relationship between trait anxiety and execution time changes depending upon which of the two instructional delivery methods is received.

Discussion. Interpreting the results using IBT, subjects with high levels of trait anxiety did not perform as well as subjects with low levels of trait anxiety ($r=.28$). Using MBT, the reverse was true but the correlation was not as strong ($r=-.15$). The interaction between level of trait anxiety and instructional delivery method was found to be statistically significant ($p<.05$).

Based on these findings it appears that there is evidence to suggest that IBT results in slower performance by individuals with higher trait anxiety than does MBT. As presented in the literature review, persons with high trait anxiety are more likely to exhibit such anxiety in situations that involve interpersonal relationships and potentially threaten self-esteem. Given the interpersonal aspects of IBT, findings in this study support prior research findings.

> $H_0$10: There is no difference in significance between the correlation of performance with level of state anxiety using MBT and the correlation of performance with level of state anxiety using IBT.

To test this hypothesis, Pearson product-moment correlations (r) were calculated for subjects in each treatment group, manual-based training and instructor-based training, to measure the relationship between the level of state anxiety and the three measures of performance. Table 4.22 presents the coefficients of correlation.

Table 4.22 Pearson product-moment correlations between measures of performance and scores on S-Anxiety Scale by instructional delivery method.

Comparisons:	MBT n=35 r	IBT n=37 r
S-Anxiety Score with:		
Training Time	.15	-.12
Execution Time	.13	-.00
Execution Errors	-.21	.05

For all three measures of performance under both instructional delivery methods, correlations with state anxiety scores were low and significance levels high (p>.05) such that we fail to reject the null hypothesis of no correlation in all cases. Tests for interaction effects between state anxiety and instructional delivery method for all three measures of performance produced results of no significant effect.

Discussion. Subjects receiving the two instructional delivery methods were not matched on S-Anxiety scores as state anxiety was measured during the treatment. A t-test comparing the mean S-Anxiety score using IBT with the mean score using MBT found no significant difference between treatments (average S-Anxiety score [standard deviation] MBT=28.74 [6.93], IBT=28.84 [7.71]; t=-.05, p>.10). Based on these findings and those reported earlier, state anxiety neither shows a relationship to performance, or explains the differences in performance between treatments in this study. Both treatments appear to have had equivalent effects on subjects with respect to generating feelings of anxiety during the experiment.

$H_0 11$: There is no difference in significance between the correlation of performance with age using MBT and the correlation of performance with age using IBT.

To test this hypothesis, Pearson product-moment correlations (r) were calculated for subjects in each treatment group, manual-based training and instructor-based training, to measure the relationship between age and the three measures of performance. Table 4.23 presents the coefficients of correlation.

Table 4.23 Pearson product-moment correlations between measures of performance and age by instructional delivery method.

Comparisons:	MBT n=35 r	IBT n=37 r
Age with:		
Training Time	.25	.11
Execution Time	.04	.13
Execution Errors	-.07	-.01

For all three measures of performance under both instructional delivery methods, correlations with age were low and significance levels high ($p>.05$) such that we fail to reject the null hypothesis of no correlation in all cases. Tests for interaction effects between age and instructional delivery method for all three measures of performance produced results of no significant effect.

Discussion. In this study age does not explain the difference in performance between treatments. While results were not significant, the direction of all the correlations between performance and age for both treatments were as would be expected from theory. On both training time and execution time, older learners appeared to take longer to complete tasks than did younger learners. Further research with a test population more evenly distributed across age groups would be necessary to determine if MBT used by older learners required significantly longer to complete than it took for younger learners.

> $H_0$12: There are no differences in performance means between subjects grouped by level of prior computer experience and by instructional delivery method.

To test this hypothesis, a multifactor analysis of variance was conducted. The analysis consisted of a 3x2 design using three levels of prior experience and two instructional delivery methods. Table 4.24 presents the results of the analysis for the performance measure of training time.

Table 4.24 Multifactor analysis of variance for mean training time by rank of prior computer experience and by instructional delivery method.

Source of Variation	Sum of Squares	D.F.	Mean Square	F Ratio	F Sig.
Main Effects	34.018	3	11.339	2.69	.053
Delivery Method	32.581	1	32.581	7.74	.007
Prior Experience	5.185	2	2.593	.62	.543
2 Factor Interaction	2.404	2	1.202	.29	.753
Residual	277.787	66	4.209		
Total	314.209	71			

Delivery Method	Prior Experience	Count	Mean*	95 Percent Confidence Interval of Mean*	
MBT	Below Avg	14	12.914	11.819	14.008
MBT	Average	16	12.072	11.048	13.096
MBT	Above Avg	5	11.744	9.912	13.576
IBT	Below Avg	7	13 706	12.157	15.254
IBT	Average	24	13.623	12.787	14.459
IBT	Above Avg	6	13.557	11.884	15.229
Total		72	13.012	12.530	13.495

*training time in minutes

The results of the analysis of variance indicate that there is a significant main effect due to the instructional delivery method (F=7.74, p<.01), but that there is neither a significant main effect or interaction effect due to prior computer experience with respect to training time.

Table 4.25 presents the multifactor analysis of variance for the performance measure of execution time by prior computer experience and by instructional delivery method.

Table 4.25 Multifactor analysis of variance for mean execution time by rank of prior computer experience and by instructional delivery method.

Source of Variation	Sum of Squares	D.F.	Mean Square	F Ratio	F Sig.
Main Effects	44.444	3	14.815	2.65	.056
Delivery Method	41.139	1	41.139	7.37	.009
Prior Experience	7.507	2	3.754	.67	.514
2 Factor Interaction	9.967	2	4.983	.89	.415
Residual	368.568	66	5.584		
Total	422.979	71			

Delivery Method	Prior Experience	Count	Mean*	95 Percent Confidence Interval of Mean*	
MBT	Below Avg	14	13.356	12.095	14.618
MBT	Average	16	14.488	13.308	15.668
MBT	Above Avg	5	12.640	10.530	14.750
IBT	Below Avg	7	12.179	10.395	13.962
IBT	Average	24	12.333	11.369	13.296
IBT	Above Avg	6	12.548	10.622	14.475
Total		72	13.035	12.479	13.591

*execution time in minutes

The results of the analysis of variance indicate that there is a significant main effect due to the instructional delivery method ($F=7.37$, $p<.01$), but that there is neither a significant main effect or interaction effect due to prior computer experience with respect to execution time.

Table 4.26 presents the multifactor analysis of variance for the performance measure of number of execution errors by prior computer experience and by instructional delivery method.

Table 4.26 Multifactor analysis of variance for mean number of execution errors by rank of prior computer experience and by instructional delivery method.

Source of Variation	Sum of Squares	D.F.	Mean Square	F Ratio	F Sig.
Main Effects	80.096	3	26.699	.32	.811
Delivery Method	23.027	1	23.027	.28	.607
Prior Experience	62.497	2	31.248	.37	.690
2 Factor Interaction	52.256	2	26.128	.31	.733
Residual	5518.523	66	83.614		
Total	5650.875	71			

Delivery Method	Prior Experience	Count	Mean*	95 Percent Confidence Interval of Mean*	
MBT	Below Avg	14	3.786	-1.095	8.666
MBT	Average	16	1.438	-3.128	6.003
MBT	Above Avg	5	.200	-7.967	8.467
IBT	Below Avg	7	2.286	-4.616	9.188
IBT	Average	24	4.000	.273	7.727
IBT	Above Avg	6	1.000	-6.455	8.455
Total		72	2.708	.556	4.860

*number of execution errors

Based on the results of the analysis, there is no significant difference (F=.319, p>.10) between the mean number of errors made between subjects grouped by prior experience level and by instructional delivery method.

Discussion. Prior computer experience in this study does not account for differences in performance between instructional delivery methods. While subjects receiving MBT with above average prior experience had average execution times over ten percent faster than subjects with average experience, that result was not found to be statistically significant. Further research which examines the nature of prior experience relative to the learning task under study would be beneficial in determining if subjects with prior experience perform better using MBT.

$H_0$13: There are no differences in performance means between subjects grouped by sex and by instructional delivery method.

To test this hypothesis, a multifactor analysis of variance was conducted. The analysis consisted of a 2x2 design using the two sexes and the two instructional delivery methods. Table 4.27 presents the results of the analysis for the performance measure of training time.

Table 4.27 Multifactor analysis of variance for mean training time by sex and by instructional delivery method.

Source of Variation	Sum of Squares	D.F.	Mean Square	F Ratio	F Sig.
Main Effects	30.210	2	15.105	3.68	.030
Delivery Method	29.396	1	29.396	7.16	.009
Sex	1.377	1	1.377	.35	.571
2 Factor Interaction	4.804	1	4.804	1.17	.283
Residual	279.195	68	4.106		
Total	314.209	71			

Delivery Method		Count	Mean*	95 Percent Confidence Interval of Mean*	
MBT	Male	14	12.212	11.131	13.293
MBT	Female	21	12.461	11.579	13.344
IBT	Male	13	14.159	13.038	15.281
IBT	Female	24	13.340	12.514	14.166
Total		72	13.012	12.536	13.489

*training time in minutes

Based on the results of the analysis (F=3.68, p<.05), we reject the null hypothesis of no differences between mean training times. The main effect difference due to instructional delivery method was significant (F=7.16, p<.01). For both men and women, training time was less for MBT than for IBT. There was no main effect or interaction effect attributable to sex with respect to training time.

Table 4.28 presents the results of the analysis for the performance measure of execution time.

Table 4.28 Multifactor analysis of variance for mean execution time by sex and by instructional delivery method.

Source of Variation	Sum of Squares	D.F.	Mean Square	F Ratio	F Sig.
Main Effects	46.902	2	23.451	4.26	.018
Delivery Method	34.944	1	34.944	6.35	.014
Sex	9.965	1	9.965	1.81	.183
2 Factor Interaction	1.627	1	1.627	1.17	.283
Residual	374.450	68	5.507		
Total	422.979	71			

Delivery Method		Count	Mean*	95 Percent Confidence Interval of Mean*	
MBT	Male	14	14.420	13.168	15.672
MBT	Female	21	13.339	12.317	14.361
IBT	Male	13	12.636	11.337	13.935
IBT	Female	24	12.177	11.221	13.133
Total		72	13.035	12.483	13.587

*execution time in minutes

Based on the results of the analysis (F=4.26, p<.05), we reject the null hypothesis of no differences between mean execution times. The main effect difference due to instructional delivery method was significant (F=6.35, p<.05). For both men and women, execution time was less for IBT than for MBT. There was no main effect or interaction effect attributable to sex with respect to execution time.

Table 4.29 presents the results of the analysis for the performance measure of number execution errors.

Table 4.29 Multifactor analysis of variance for mean number of execution errors by sex and by instructional delivery method.

Source of Variation	Sum of Squares	D.F.	Mean Square	F Ratio	F Sig.
Main Effects	147.389	2	73.695	.96	.387
Delivery Method	22.677	1	22.677	.30	.594
Sex	129.790	1	129.790	1.69	.198
2 Factor Interaction	293.193	1	293.193	3.83	.055
Residual	5210.293	68	76.622		
Total	5650.875	71			

Delivery Method		Count	Mean*	95 Percent Confidence Interval of Mean*	
MBT	Male	14	1.357	-3.312	6.026
MBT	Female	21	2.762	-1.051	6.574
IBT	Male	13	7.692	2.847	12.538
IBT	Female	24	.750	-2.816	4.316
Total		72	13.035	.649	4.767

*number of execution errors

Based on the results of the analysis (F=.962, p>.10), we fail to reject the null hypothesis of no difference between means. We conclude that there is no significance difference in the number of execution errors made based on sex and delivery method, or their interaction.

<u>Discussion</u>. The sex of the subjects in this study did not account for differences in performance between instructional delivery methods.

Further Analysis

Of the six independent variables studied, only the individual characteristic of field-dependence was found to be significantly related to performance. Specifically, there was discovered to be a significant negative correlation between GEFT score and the performance measure of execution time, the time required to complete a series of representative tasks. When controlling for delivery method received this correlation was only significant for the MBT treatment.

To further describe the relationship between level of field-dependence and execution time using MBT, simple regression analysis was performed with execution time as the dependent variable and GEFT score as the independent variable. The results of that analysis, using the general linear model of Y = a + bx, were:

$$\text{Execution Time (in minutes)} = 16.26 - .205\ \text{GEFT Score}$$

$$t = -2.08$$

$$R^2 = 11.60 \text{ percent} \qquad p < .05$$

From this analysis we would conclude that, using MBT, the relationship between execution time and GEFT score is negative and that 11.60 percent of the variation in execution time is explained by linear regression on the GEFT variable. Given the observed range of GEFT scores of between 3 and 18, this variable would account for differences in performance of between 0.6 and 3.7 minutes.

Summary of Findings

Following is a summary of findings relative to the dependent and independent variables of this study, and the instructional delivery methods used as treatments.

Measures of Performance

Three measures of performance were selected for use in this study as dependent variables: training time, execution time, and number of execution errors. Training time as a dependent variable was of limited value, except in measuring the difference in efficiency between the two instructional delivery methods. Tests for relationships between training time and level of field-dependence, trait anxiety, state anxiety, prior computer experience, sex, and age all were found to be not statistically significant. Similarly, number of execution errors as a dependent variable failed to significantly relate to any of the independent variables of the study, or failed to explain the observed difference in results between instructional delivery methods.

Of the three measures of performance, execution time - the time required to complete a series of representative tasks - was of greatest utility in measuring differences in performance due to learner characteristics and instructional delivery method. Statistically significant differences in training time were observed related to the different instructional delivery methods and level of field dependence.

Learner Characteristics

Six individual characteristics were selected for this study as the independent variables: level of field-dependence, trait anxiety, state anxiety, age, sex, and level of prior computer experience.

Field dependence. Of the six learner characteristics examined in this study, the level of field dependence as measured by scores on the GEFT showed the greatest relationship to performance in operating a computer system. In performing representative tasks, the GEFT score showed a statistically significant negative correlation to execution time ($r=-.28$, $p<.01$) indicating that relatively field independent subjects were able to perform significantly faster than field dependent subjects. Controlling for instructional delivery method received, level of field dependence was found to significantly relate to execution time for MBT but not for IBT.

Trait anxiety. The high correlation between trait anxiety and state anxiety ($r=.36$, $p<.01$) indicated that subjects experiencing state anxiety during training were prone to being anxious. Unexplained was the negative correlation ($r=-.27$, $p<.05$) between trait anxiety and age, indicating that older subjects exhibited lower levels of trait anxiety. Such a finding could either be attributed to sampling error (a bias in the older subjects selected for this study), or to a general characteristic of older college students.

Differences in trait anxiety failed to correlate at a statistically significant level with measures of performance.

State anxiety. In addition to the correlation noted above between trait anxiety and state anxiety, this variable also showed a significant negative correlation with prior computer experience ($r=-.25$, $p<.05$). Such a correlation indicates that subjects with prior computer experience exhibited less anxiety in response to the training activity. Differences in state anxiety failed to correlate at a statistically significant level with measures of performance.

Age. As discussed above, age showed a positive correlation to trait anxiety. Age, however, failed to correlate at a statistically significant level with measures of performance.

Prior computer experience. While prior experience showed a negative correlation with state anxiety as noted above, it failed to correlate significantly with any of the three measures of performance.

Sex. Sex failed to show any significant correlations to either other learner characteristics, or to any of the three measures of performance.

Instructional Delivery Methods

Subjects were trained to use a computer software system using one of two instructional delivery methods, manual-based training and instructor-based training. In comparing manual-based training with instructor-based training the following significant differences were found:

1. Training time for instructor-based training took significantly longer than did training time for manual-based training.
2. Execution time for manual-based training took significantly longer than did execution time for instructor-based training.
3. No difference occurred between the two methods with respect to number of execution errors.

For MBT, a significant negative correlation was discovered between level of field-dependence and execution time. The more field-independent a subject was as measured by the GEFT, the shorter the execution time. An interaction effect was measured between instructional delivery method and level of trait anxiety. People with higher trait anxiety appear to have performed better under MBT than under IBT.

CHAPTER 5

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Chapter 5 is organized into three sections: Summary, Conclusions, and Recommendations. The summary section provides a brief summary of the first four chapters. The conclusions section provides an interpretation of the findings and a discussion of the implications to the training of computer operators and to the broader field of instructional design. The chapter concludes with a section of recommendations based on the findings of this study. Two types of recommendations are provided: training design recommendations and recommendations for further research.

Summary

Three major trends during the past two decades have motivated researchers to investigate personal and situational factors surrounding users of computer systems. The three trends have been: (1) an expanding range of computer users, (2) changes in the nature of computer systems, and (3) the need to continually upgrade computer skills. These trends support the ever increasing need for training of operators of computer systems, and the associated need for increasing the effectiveness of that training through methodological research.

A major difficulty in developing a unified body of knowledge in this area has been the problem of attempting to generalize findings to a very broad spectrum of situations and applications. No commonly accepted classification schema has been offered to coordinate research efforts. Three candidate dimensions for classification identified in the literature were: (1) major user groups - computer engineers, programmers, system operators, and computer users; (2) general computer function - process control, inventory maintenance, arithmetic calculation, and verbal or graphic manipulation; and (3) primary computer application - life-critical systems, industrial and commercial uses, office/home/entertainment applications, and exploratory/creative/ expert systems. Research to date has focused primarily on programmers, performing verbal or graphic manipulation tasks, in the office or expert system setting. Little research has focused on computer users performing inventory maintenance tasks in the commercial setting, and yet, millions of individuals are being required to operate computers in this category every day. It is on this segment, or cell in the classification schema, that this research was focused.

Learner characteristics of concern in prior research have included: age, anxiety, attitudes, closure, cognitive style, sex, learning strategy, locus of control, motivation, personality types, prior computer experience, and spatial memory. Results of such research have been mixed. This study investigated the characteristics of cognitive style, anxiety, age, sex, and prior computer experience.

Objectives of the Study

The specific objectives of this study were:

1. To determine if individual differences in the learner characteristics of field dependence, state and trait anxiety, age, sex, and prior computer experience were related to performance in operating a computer system.

2. To determine if differences in performance would occur as a result of two different instructional delivery methods, manual-based training and instructor-based training.

3. To determine if differences in performance between instructional delivery methods could be partially explained by differences in the learner characteristics examined.

Hypotheses of the Study

To achieve the objectives of this study the following hypotheses were tested:

$H_0$1: There is no correlation between a subject's performance and the subject's level of field dependence.

$H_0$2: There is no correlation between a subject's performance and the subject's level of trait anxiety.

$H_0$3: There is no correlation between a subject's performance and the subject's level of state anxiety.

$H_0$4: There is no correlation between a subject's performance and a subject's age.

$H_0$5: There is no difference in performance between subject's grouped by level of prior computer experience.

$H_0$6: There is no difference in performance between male and female subjects.

$H_0$7: There is no difference in performance between subjects trained using manual-based training (MBT) and subjects trained using instructor-based training (IBT).

$H_0$8: There is no difference in significance between the correlation of performance with level of field dependence using MBT and the correlation of performance with level of field dependence using IBT.

$H_0$9: There is no difference in significance between the correlation of performance with level of trait anxiety using MBT and the correlation of performance with level of trait anxiety using IBT.

$H_0$10: There is no difference in significance between the correlation of performance with level of state anxiety using MBT and the correlation of performance with level of state anxiety using IBT.

$H_0 11$: There is no difference in significance between the correlation of performance with age using MBT and the correlation of performance with age using IBT.

$H_0 12$: There are no differences in performance means between subjects grouped by level of prior computer experience and by instructional delivery method.

$H_0 13$: There are no differences in performance means between subjects grouped by sex and by instructional delivery method.

Design of the Study

To test the hypotheses of this study an experimental research design was used. The study involved two groups of subjects, one considered the experimental group and the other the control group. Subjects in the control group were trained to operate a Master Beverage Management System (MBMS) computer software package using a manual-based instructional delivery method. Subjects in the experimental group were trained to use the same system using an instructor-based instructional delivery methods. Participants in the study were 72 undergraduate students enrolled in one or more courses in Hotel, Restaurant and Tourism Management at Oregon State University in April of 1987.

Subjects were administered two standardized instruments, the Group-Embedded Figures Test (GEFT) and the T-Anxiety Scale of the State-Trait Anxiety Inventory (STAI), and a demographic questionnaire which identified age, sex, and a measure of prior computer experience. Subjects signed up for training groups. Mean scores on the GEFT and T-Anxiety scale for each group were compared and similar groups were paired. One group from each pair was randomly assigned to receive each treatment.

The experiment consisted of three steps. The first step was training each group of subjects to operate the MBMS system using either a manual-based or instructor-based delivery method. The second step was measuring the subject's level of state anxiety immediately following training using the S-Anxiety scale of the STAI (on the computer). The third step was having subjects complete a series of representative problems using MBMS. Performance measures taken during the experiment were: (1) training time, time required to complete training, (2) execution time, time required to complete the representative problems, and (3) execution errors, number of errors remaining following completion of the representative problems.

Treatment of the Data

The first six hypotheses of this study were concerned with the relationship between performance and learner characteristics. Pearson product-moment correlations were applied in examining relationships between measures of performance and the learner characteristics of field dependence, trait anxiety, state anxiety, and age. Oneway analysis of variance was applied in testing differences in performance between subjects grouped by sex and by level of prior computer experience.

The seventh hypothesis was concerned with the difference in performance between manual-based and instructor-based training. T-tests were applied in measuring difference in performance between the two instructional delivery methods.

The last six hypotheses were concerned with determining if the relationship between learner characteristics and performance are different as a result of different instructional delivery methods. Pearson product-moment correlations between performance measures and the learner characteristics of field dependence, trait anxiety, state anxiety, and age were calculated for subjects in each treatment group. The correlations were then compared for differences in level of significance. Multifactor analysis of variance was applied to determine if differences in mean performance occurred between subjects grouped by delivery method and sex, or prior computer experience. Multifactor analysis of variance was also used to identify interaction effects between each independent variable and the instructional delivery methods.

Statistically Significant Findings

The first six hypotheses of this study were concerned with the relationship between performance and the learner characteristics examined in this research: field dependence, trait anxiety, state anxiety, age, sex, and prior computer experience. The major significant finding of this study related to these hypotheses was:

1. There was a statistically significant, negative correlation between execution time and level of field dependence. Subjects who were more field independent (higher GEFT score) took less time to perform the representative tasks.

The seventh hypothesis of this study was concerned with differences in performance that occurred as a result of instructional delivery method. The major findings related to this hypothesis were:

2. There was a statistically significant difference in training time between manual-based and instructor-based training. Subjects trained using IBT took longer to train than did subjects using MBT.

3. There was a statistically significant difference in execution time between manual-based and instructor-based training. Subjects trained using MBT took longer to complete the representative problems than did subjects using IBT.

The last six hypotheses of this study were concerned with determining if differences in the relationships between performance and learner characteristics would occur as a result of instructional delivery method received. The significant findings related to these hypotheses were:

4. The negative correlation between field dependence and execution time was statistically significant for MBT but not for IBT.

5. For the performance measure of execution time there was a significant interaction effect between trait anxiety and instructional delivery method. Subjects with high trait anxiety performed faster using MBT. Subjects with high trait anxiety performed slower using IBT.

Conclusions

A review of the literature revealed a need to examine the personal and situational factors which moderate the effectiveness of alternative training methods. This study established three objectives to begin to provide such an examination. The following discussion is presented according to the objectives as originally presented in the research.

Objective 1. To determine if individual differences in the learner characteristics of field dependence, state and trait anxiety, age, sex, and prior computer experience were related to performance in operating a computer system.

For the population studied in this research, only the field dependence/independence dimension of cognitive style showed a significant relationship to performance in operating a computer system.

Specifically, it was shown that a significant negative correlation exists between subjects scores on the GEFT and time required to complete a series of representative tasks, indicating that subjects who were relatively field independent performed the tasks faster than subjects who were relatively field dependent.

The learner characteristics of trait anxiety, state anxiety, age, sex, and prior computer experience all failed to significantly correlate with measures of performance. For the characteristic of sex, based on the findings, we may conclude that for the population from which the sample was drawn, undergraduate college students, there was no difference in performance due to sex. For the remaining characteristics the results could be explained in one of two ways: either there is truly no correlation, or the sampled population from which subjects were drawn is so homogeneous with respect to the variables of investigation that there is insufficient variation to test these hypotheses. Given a sample population with greater variation in age, state anxiety, trait anxiety, and prior computer experience, the results might be different.

Objective 2. To determine if differences in performance would occur as a result of two different instructional delivery methods, manual-based training and instructor-based training.

Results of this study showed that there were statistically significant differences in performance between manual-based and instructor-based training. Average training time for MBT was shorter than training time for IBT. Conversely, execution time for IBT trained subjects was faster than for MBT trained subjects completing the same representative tasks.

Observations during the experiment provide two explanations for the difference in training time. Time required for training using IBT, a group-paced method, was influenced heavily by (1) the pace set by the instructor, and (2) to the speed of the slowest learner in the group. Time spent waiting for subjects to complete a step in the training process depended upon waiting for the slowest person. Students who learned faster often had to wait for the last one to finish the step before the instructor moved on in the instruction. However, IBT also insured that subjects were thoroughly trained and were required to practice each of the operational skills required to use the system. Difficulties, when they occurred, were brought to the attention of the instructor who assisted in correcting any problems and explained important concepts to the point of understanding by the subject.

Subjects learning by MBT typically proceeded at a rapid pace through the training material. These subjects were commonly observed completing the exercises included in training in a step-by-step fashion without apparent consideration of the significance or content of the activities. When MBT subjects completed training and performed the representative tasks, many were observed referring back to the training material indicating that the training had not been sufficient to complete the task without further assistance.

Differences in execution time are similarly explained. Subjects trained by IBT: (1) did not spend time referring back to training (as there was no printed material to refer back to), (2) focused full attention to the computer system, its instructions and requests for information, and (3) appeared to be better able to relate their practice exercises during training to the representative tasks they were requested to perform. Subjects trained by MBT: (1) spent time referring back to the training manual, thus increasing performance time, and (2) divided their attention between the computer and the printed materials.

Objective 3. To determine if differences in performance between instructional delivery methods could be partially explained by differences in the learner characteristics examined.

Two learner characteristics were found to differ between the two instructional delivery methods. The level of field dependence/ independence showed a stronger correlation for MBT than it did for IBT. The greater the level of field independence, the shorter the execution time for MBT. The relationship was not found to be statistically significant for IBT. Based on this finding we could conclude that field independent subjects are able to learn more effectively using MBT than are more field dependent subjects when the measure of performance is time required to complete representative problems following training. The lack of a significant correlation in the IBT case could be explained by the ability of that training delivery method to mediate differences in performance between field dependent and independent learners.

The second significant finding related to instructional delivery method was a significant interactive effect between delivery method and trait anxiety for the performance measure of execution time. Individuals with higher trait anxiety (anxiety proneness) learning by MBT appear to perform better than high trait anxiety people learning by IBT. In this study, IBT actually caused people with high trait anxiety to perform less well, indicating that something related to the IBT method interacted with the subject's anxiety proneness to result in poor performance. Additional research is necessary to further explain this result.

Implications for Training of Computer Operators

Based on the results of this study, the following conclusions can be drawn which may impact the training of computer operators:

1. Evidence has been provided that cognitive style, and specifically level of field dependence, has a relationship to performance on computer tasks. Field-independent subjects demonstrated an ability, after training, to perform faster than field-dependent subjects. As cognitive style is an individual characteristic, and not a learned skill, it may partially account for difference in performance between individuals with apparently similar skills and abilities.

2. Different instructional delivery methods result in different levels of performance efficiency. Manual-based training took less time to complete, on average, than did instructor-based training. However, in this study, instructor-based training led to faster performance, as measured by average execution time, than did manual-based training. Evaluation of training efficiency needs to consider both the training inputs and performance outputs.

3. Preliminary evidence from this study would indicate that field-independent learners performed better as a result of having learned using manual-based training, as opposed to instructor-based training. If this finding is generalizable to other settings (which

needs to be tested by further research), then the implication is that the most effective instructional delivery method to train an individual to operate a computer system should be prescribed based upon that individual's cognitive style. Given the situation of having to select only one delivery method, from this study it would appear that instructor-based training better accommodates, on average, the needs of both the field dependent and field independent learner resulting in the faster average performance following training.

Implications for Education in General

Research reviewed in this study establishes that people have different cognitive styles - ways in which they structure information and ways in which they process information. Further, the evidence from this study indicates that different cognitive styles, and potentially other individual differences, interact with instructional delivery methods making certain methods more effective than others for people with specific individual characteristics. From these findings there is reason to hypothesize that for a specific individual, given the ability to identify and measure all personal characteristic variables that impact learning and learning style, we should be able to prescribe the most effective instructional delivery method. The purpose of this study was to take an early step in achieving this goal.

A major premise of pedagogy, the teaching of children, is that the instructor knows what is best for the child and the instructional approach that will be most effective. In andragogy, the science of educating adults as developed by Malcolm Knowles, a major premise is that the teacher must consider the nature of the individual learner.

Perhaps poor or mediocre performance observed in the past has been partially the result of inappropriately prescribed instructional methods, not poor individual performance alone. As indicated by this research, a field-dependent learner assigned to the MBT delivery method may not have performed as well as had he been assigned to the IBT delivery method. The difference in performance may not be due to any conscious activity of the subject, but rather to the appropriateness or inappropriateness of the instructional delivery method with respect to that individual's personal learning style.

Failure to recognize individual differences, and how those differences interact with training delivery methods and other variables of education, may cause us to falsely evaluate the true performance of individuals. Just as some machines in industry must be redesigned to be effectively operated by left-handed people as well as right-handed people, so should the tools of training be adaptable to individual differences in cognitive style and other relevant characteristics. In this study, comparing the performance of a field-dependent learner with that of a field-independent learner both trained by MBT might be equivalent to evaluating the performance of a left-handed and right-handed person on performance using a machine for right-handed people. While the left-handed person would not perform as well, it has nothing to do with effort or ability, it is simply application of an inappropriate tool.

Recommendations

Based on the results of this study, and the conclusions above, the following recommendations are made relating to the development of instructional delivery systems, along with recommendations for further research to explore the generalizability of this field of investigation.

Recommendations for Instructional Design

The data collected from this study tend to support the hypothesis that individual differences, and specifically level of field dependence, impacts the resulting performance of different instructional training methods in training operators of computer systems. The study also shows that different levels of performance can result from different instructional delivery methods. Based on such findings it becomes important that the instructional designer consider: (a) the training delivery method, (b) the individual characteristics of the learner, and (c) the interaction of these two elements when designing instructional delivery systems. Designers should test and evaluate multiple delivery methods, and, when possible, offer alternative methods to learners allowing them to use a system which compliments their learning style.

Recommendations for Further Research

This research was designed to begin an investigation in an area previously not explored to any great extent using scientific methods. Its purpose was to determine if any further investigation in this area is warranted. Being a pilot study it had limitations. Those limitations included a specialized test population, use of a new computer software package, and development and administration of the experimental treatments by the primary investigator.

Recognizing the limitations of this research, the following recommendations are made to expand the generalizability and application of its findings.

Population characteristics. While findings of no significant relationship were found between measures of performance and the individual characteristics of age, state anxiety, and trait anxiety, such findings may be due to the homogeneity of the test population. Lack of sufficient variation in the independent variable will always result in a finding of no significant relation to the dependent variable. While the findings of no significant relationships may be applicable to this test population, such may not be the case for other populations. The significance of these individual differences needs to be tested in other settings with other populations to fully explain variations in performance due to different training delivery methods.

Study population. As previously discussed, a major difficulty in developing a unified body of knowledge in this area has been the problem of attempting to generalize findings to a very broad spectrum of situations and applications. In the classification schema presented, this study would be classified as pertaining to computer users (major user group) performing inventory maintenance tasks (general computer function) in a commercial setting (primary computer application). By replicating the study in the other 63 cells of the schema and comparing the findings, we would begin to identify the generalizability of findings to the general population. With some individual differences, such as state anxiety, we would expect findings to be different and generalizable only within a given cell. However with other factors, such as level of field dependence, we might expect to find common results throughout all test settings. Further research is required to test such hypotheses.

Target tasks. This study used a specialized computer software system, Master Beverage Management System, as the target task of investigation. This system was chosen as it: (1) ensured that subjects had not had prior experience in using the system, (2) ensured that the system training manual was designed to incorporate current theory and practice related to system documentation, and (3) allowed the computer to capture and record measures of the dependent variables of concern in the study. Replication of the basic methodology with more widely used software in commercial setting such as DBaseIII+ or Lotus 1-2-3 might provide more generally applicable results. Such a design would need to be more sophisticated to permit for the more complex software package and the longer learning times involved.

Performance measures. This study used execution time as a measure of performance, the time required to complete a series of representative tasks immediately following training. While this variable measured the subject's level of understanding based on the training received, it did not measure long-term retention of that knowledge. Replication of the study adding a second execution test at some period of time after training would provide an additional measure of performance indicating the effectiveness of a training delivery method in knowledge retention over time.

Instructional delivery methods. This research examined MBT and IBT as representative of two major modes of instructional delivery, group-paced learning and self-paced learning. As presented in Table 2.3 on page 37, these are only two of a list of instructional delivery methods in common use. Replication of this research for other common delivery methods such as video tape and disk-based tutorials is necessary to determine if the findings of this study can be generalized across all types of training in each general delivery category.

Controlling for instructor. A major design consideration of this study was controlling for individual instructor characteristics. To control the instructional content the instructor read the manual to the subjects. Training between IBT groups was controlled by using the same instructor for all training sessions. The effect of the instructor's characteristics on training time was not controlled.

Training time was regulated primarily by the instructor. Pacing of instruction, responding to questions, and the personality characteristics of the instructor which either may encourage or discourage subjects to ask questions all will dramatically have an impact upon average training time. In this study we were able to conclude only that a difference in training time between treatments occurred. Given a different instructor, with different characteristics, the results might change.

To determine if training time for delivery methods differ, the study should be replicated with a larger number of instructors, preferably those unaware of the nature of the experiment. While a greater variation in average training time between instructors and groups would be anticipated, the results would allow greater latitude to generalize the findings about training time required for more than one training delivery method.

Summary. This study was designed as a pilot study to determine if individual characteristics and instructional delivery methods are related to performance in operating a computer software system. Results of the study indicated that level of field dependence and instructional delivery method interact to effect performance. Based upon these results, further research appears warranted to better define the relationship of these variables to performance.

LITERATURE CITED

Alexander, B.H. (1982). Impact of computers on human behavior. Vital Speeches of the Day, 185-188.

Alluisi, E.A. and Morgan Jr., B.B. (1976). Engineering psychology and human performance. Annual Review of Psychology, 27, 305-330.

Allwood, C.M. (1986). Novices on the computer: A review of the literature. International Journal of Man-Machine Studies, 25, 633-658.

Arenberg, D., and Robertson-Tchabo, E.A. (1977). Learning and aging. In J.E. Birren and K.W. Schaie (Eds.), Handbook of the psychology of aging, New York: Van Nostrand Reinhold.

Armstrong, J.M. (1980). Achievement and participation of women in mathematics: An overview, Denver: Education Commission of the States.

Auerbach, S.M. (1973). Trait-state anxiety and adjustment to surgery. Journal of Clinical Psychology, 33, 264-271.

Auld, R., Lang, K. and Lang, T. (1981). University computer users: Characteristics and behaviour. In M.J. Coombs and J.L. Alty (Eds.), Computing Skills and the User Interface, New York: Academic Press, 73-113.

Bailey, R.W. (1982). Human performance engineering: A guide for system designers, Englewood Cliffs, New Jersey: Prentice-Hall.

Bangert-Drowns, R.L., Kulik, J.A., and Kulik, C.C. (1982). The coming of age of educational technology: Meta-analyses of outcome studies of computer-based instruction. In J. Smith (Ed.), Proceedings of NECC-82 National Educational Computing Conference 1982, June, 168-171.

Bauman, G. (1951). The stability of the individual's mode of perception, and of perception-personality relationships. Unpublished doctoral dissertation, New York University.

Baxter, P. (1984). Bring your computer training manuals down to earth. Training and Development Journal, September, 55-59.

Benbow, C. and Stanley, J. (1980). Sex differences in mathematical ability: Fact or artifact?. Science, 12, 1262-1264.

Bloom, A.J. (1985). An anxiety management approach to computerphobia. Training and Development Journal, 90-94.

Boswell, S.L. (1979). Nice girls don't study mathematics: The perspective from elementary school. A paper presented at the annual meeting of the American Educational Research Association, San Francisco, April.

Bruner, J.S., Goodnow, J.J. and Austin, G.A. (1956). A study of thinking. New York: Wiley.

Bryan Jr., L.A. (1986). Supervisors with micros: Trends and training needs. Training and Development Journal, July, 38-39.

Buros, O.D. (1978). The eighth mental measurements yearbook. Hyde Park, New Jersey: Gryphon Press.

Callaghan, D.R. (1985). Realistic computer training. Training and Development Journal, July, 27-29.

Carroll, J.M. (1984). Minimalist training. Datamation, November 1, 125-136.

Carroll, J.M. and Mack, R.L. (1984). Learning to use a word processor: By doing, by thinking and by knowing. In J.C. Thomas and M.L. Schneiderman (Eds.), Human Factors in Computer Systems, Norwood, New Jersey: Ablex Publishing, 13-51.

Carroll, J.M. and Carrithers, C. (1984). Blocking learner error states in a training-wheels system. Human Factors, 26(4), 377-389.

Carroll, S.J., Paine, F.T. and Ivancevich, J.J. (1972). The relative effectiveness of training methods: Expert opinion and research. Personnel Psychology, 25, 495-509.

Cattell, R.B. (1966). Patterns of change: Measurement in relation to state dimension, trait change, ability, and process concepts. Handbook of multivariate experimental psychology. Chicago: Rand McNally.

Cattell, R.B. and Scheier, I.H. (1961). The meaning and measurement of neuroticism and anxiety. New York: Ronald Press.

Cattell, R.B. and Scheier, I.H. (1963). Handbook for the IPAT Anxiety Scale, (2nd Edition). Champaign, Illinois: Institute for Personality and Ability Testing.

Cerella, J., Poon, L.W. and Williams, D.M. (1980). Age and complexity hypothesis. In L.W. Poon (Ed.), Aging in the 1980s, Washington, DC: American Psychological Association, 332-340.

Chapanis, A. (1965). Man-machine engineering, Monterey, California: Brooks/Cole.

Christensen, L.B. (1980). Experimental methodology (2nd Edition). Boston, Massachusetts: Allyn and Bacon.

Churbuck, D. (1986). Training options: Each has drawbacks, benefits. PC Week, May 1, 132-133.

Coombs, M.J. and Alty, J.L. (Eds.) (1981). Computing skills and the user interface, New York: Academic Press.

Coombs, M.J., Gibson, R., and Alty, J.L. (1981). Acquiring a first computer langauge: A study of individual differences. In M.J. Coombs and J.L. Alty (eds) Computing skills and the user interface. New York: Academic Press, 289-313.

Coovert, M.D. and Goldstein, M. (1980). Locus of control as a predictor of user's attitude toward computers. Psychological Reports, 47, 1167-1173.

D'Arcy, J. (1984). Learning Pascal after BASIC. Human-Computer Interaction - Interact '84, B. Shackel (Ed.), North-Holland: Elsevier Science Publishers B.V.

Dambrot, F.H., Watkins-Malek, M.A., Silling, S.M., Marshall, R.S. and Garver, J.A. (1985). Correlates of sex differences in attitudes toward and involvement with computers. Journal of Vocational Behavior, 27, 71-86.

DeBono, E. (1967). The use of lateral thinking. London: Jonathan Cape.

Deck, J.G. and Sebrechts, M.M. (1984). Variations on active learning. Behavior Research Methods, Instruments, & Computers, 16(2), 238-241.

Eason, K.D. (1976). Understanding the naive computer user. Computer Journal, 19(1), 3-7.

Eason, K.D. and Damodaran, L. (1981). The needs of the commercial user. In M.J. Coombs and J.L. Alty (Eds.), Computing skills and the user interface, New York: Academic Press, 115-139.

Egan, D.E. and Gomez, L.M. (1985). Assaying, isolating and accommodating individual differences in learning a complex skill. In R.F. Dillon (Ed.), Individual differences in cognition, Vol 2, New York: Academic Press, 173-217.

ERIC (1987). Thesaurus of ERIC Descriptors, 11th edition, J.E. Houston (Ed.), Phoenix, Arizona: Oryx Press.

Fennema, E. and Sherman, J. (1977). Sexual stereotyping and mathematics learning. Arithmetic Teacher, May, 369-372.

Fitter, M., Brownbridge, G., Barber, B. and Herzmark, G. (1985). A human factors evaluation of the IBM Sheffield Primary Care System. Human-Computer Interaction - Interact '84, B. Shackel (eds). Amsterdam: Elsevier Science Publishers B.V.

Freud, S. (1936). The problem of anxiety. New York: W.W. Norton.

Galagan, P. (1983). Treating computer anxiety with training. Training and Development Journal, 57-60.

Gardner, R.W., Jackson, D.N., and Messick, S.J. (1960). Personality organization in cognitive controls and intellectual abilities. Psychological Issues, 2(4), Monograph 8.

Gomez, L.M., Egan, D.E. and Bowers, C. (1986). Learning to use a text editor: Some learner characteristics that predict success. Human-Computer Interaction, 2, 1-23.

Goodenough, D.R. (1976). The role of individual differences in field dependence as a factor in learning and memory. Psychological Bulletin, 83(4), 675-694.

Goodwin, L. and Sanati, M. (1986). Learning computer programming through dynamic representation of computer functioning: Evaluation of a new learning package for Pascal. International Journal of Man-Machine Studies, 25, 327-341.

Gottschaldt, K. (1926). Uber den einfluss der erfahrung auf die wahrnehmung vin figuren 1, uber den einfluss gehaufter eingragung von figuren auf ibre sichtbarkeit in umfassenden konfigurationen. Psuchol. Forsch., 8, 261-317.

Green, T.R.G. (1980). Programming as a cognitive activity. In H.T. Smith and T.R.G. Green (Eds.), Human interaction with computers, London: Academic Press.

Hall, M. (1985). Oral tradition. Datamation, August 1, 127-128.

Hansen, W.J. (1971). User engineering principles for interactive systems. Proceedings of the fall joint computer conference, 39, Montvale, New Jersey: AFIPS Press, 523-532.

Hodges, W.F. and Spielberger, C.D. (1966). The effects of threat of shock on heart rate for subjects who differ in manifest anxiety and fear of shock. Psychophysiology, 2, 287-294.

Hoffman, J.L. and Waters, K. (1982). Some effects of student personality on success with computer-assisted instruction. Educational Technology, March, 20-21.

Hudson, L. (1966). Contrary imaginations. London: Penguin.

Hughes, C.T. (1986). Adequacy of computer training for the non-data processing manager. Journal of Systems Management, January, 15-17.

Hultsch, D.F. (1974). Learning to learn in adulthood. Journal of Gerontology, 29, 302-308.

Jagodzinski, A.P. (1983). A theoretical basis for the representation of on-line computer systems to naive users. International Journal of Man-Machine Studies, 18, 215-252.

James, E.B. (1981). The user interface: How we may compute. In M.J. Coombs and J.L. Alty (Eds.), Computing skills and the user interface, New York: Academic Press, 337-371.

Kazlauskas, E.J. and McCrady, J.C. (1985). Microcomputer training approaches: Review and evaluation criteria. Microcomputers for Information Management, 2(2), 91-101.

Kennedy, T.C.S. (1975). Some behavioral factors affecting the training of naive users of an interactive computer system. International Journal of Man-Machine Studies, 7, 817-834.

Kiesler, S., Sproull, F. and Eccles, J.S. (1983). Second class citizens? Psychology Today, March, 40-48.

Knowles, M.S. (1983). Malcolm Knowles finds a worm in his apple. Training and Development Journal, May, 12-15.

Levy-Argesti, J. and Sperry, R. (1968). Differential perceptual capacities in major and minor hemispheres. Proceedings of the National Academy of Sciences, 61.

Linton, H.B. (1952). Relations between mode of perception and tendency to conform. Unpublished doctoral dissertation, Yale University.

Linton, H.B. and Graham, E. (1959). Personality correlates of persuasability. In I. Janis (Ed.), Personality and Persuasability, New Haven, Connecticut: Yale University Press, 69-101.

Little, T.C. (1985). Managing computerphobia. Supervisory Management, 30, June, 8-12.

Long, H.B. (1983). Adult and continuing education. New York: Teachers College Press.

Longenecker, E.D. (1956). Form perception as a function of anxiety, motivation, and the testing situation. Unpublished doctoral dissertation, University of Texas.

Lovell, R.B. (1980). Adult learning. New York: John Wiley and Sons.

Luria, A.R. (1966). Higher cortical functions in man. New York: Basic Books.

Martinez-Urrutia, A. (1975). Anxiety and pain in surgical patients. Journal of Consulting and Clinical Psychology, 43, 437-442.

Mayer, R.E. (1981). The psychology of how novices learn computer programming. Computing Surveys, 13(1), 121-141.

Mayer, S.R. (1967). Computer-based subsystems for training the users of computer systems. IEEE Transaction on Human Factors in Electronics, 8(2), 70-75.

Mooney, R.L. and Gordon, L.V. (1950). Manual of the Mooney Problem check lists. College Form, New York: Psychological Corporation.

Moran, T.P. (1981). An applied psychology of the user. ACM Computing Surveys, 13(1), 1-12.

Mumford, E. (1980). The design of computer-based information systems: an example of practice without theory: a report. Manchester Business School. Cited in Jagodzinski, A.P. (1983). A theoretical basis for the representation of on-line computer systems to naive users. International Journal of Man-Machine Studies, 18, 215-252.

Murrell, K.F.H. (1965). Ergonomics: Man in his working environment, London: Chapman and Hall.

Nash, A.N., Muczyk, J.P. and Vettori, F.L. (1971). The relative practical effectiveness of programmed instruction. Personnel Psychology, 397-418.

Nebelkopf, E.B. and Dreyer, A.S. (1973). Continuous-discontinuous concept attainment as a function of individual differences in cognitive style. Perceptual and Motor Skills, 36, 655-662.

Newell, A. and Simon, H.A. (1972). Human problem solving, Englewood Cliffs, New Jersey: Prentice-Hall.

Nickerson, R.S. (1969). Man-computer interaction: A challenge for human factors research. IEEE Transactions on Man-Machine Studies, 10, 164-180.

Nowaczyk, R.H. (1984). The relationship of problem-solving ability and course performance among novice programmers. International Journal of Man-Machine Studies, 21, 149-160.

Oltman, P.K., Raskin, E., and Witkin, H.A. (1971). Group Embedded Figures Test. Palo Alto, California: Consulting Psychologists Press.

Paivio, A. (1971). Imagery and verbal processes. New York: Holt, Rinehart and Winston.

Parsons, H.M. (1970). The scope of human factors in computer-based data processing systems. Human Factors, 12(2), 165-175.

Pask, G. (1976a). Conversational techniques in the study and practice of education. British Journal of Educational Psychology, 46, 12-25.

Pask, G. (1976b). Styles and strategies of learning. British Journal of Educational Psychology, 46, 128-148.

Pask, G. (1976c). Conversation theory: Applications in education and epistemology. Amsterdam: Elesvier Science Publishers B.V.

Paxton, A.L. and Turner, E.J. (1984). The application of human factors to the needs of the novice computer user. International Journal of Man-Machine Studies, 20, 137-156.

Paznik, M.J. (1986). Making people fell comfortable with technology is a manager's job. Administrative Management, August, 8.

Pepper, J. (1986). Introducing new systems to users. PC Week, May 1, S15-S22.

Reardon, R., Jolly, E.J., McKinney, D., and Forducey, P. (1982). Field-dependence/independence and active learning of verbal and geometric material. Perceptual and Motor Skills, 55, 263-266.

Rich, E. (1983). Users are individuals: individualizing user models. International Journal of Man-Machine Studies, 18, 199-214.

Rosser, P. (1982). Do schools teach computer anxiety? Ms, December, 15.

Rosson, M.B. (1984). Effects of experience on learning, using, and evaluating a text editor. Human Factors, 26(4), 463-475.

Rosson, M.B. (1985). The role of experience in editing. In B. Shackel (Ed.), Human-Computer Interaction - INTERACT '84, North-Holland: Elsevier Publishers.

Scharer, L.L. (1983). User training: Less is more. Datamation, July, 175-182.

Schmidt, C.P. (1984). The relationship among aspects of cognitive style and language-bound/language optional perception to musicians' performance in aural discrimination tasks. Journal of Research in Music Education, 32(3), 159-168.

Sells, L.W. (1980). Mathematics: The invisible filter. Engineering Education, 70, 340-341.

Shneiderman, B. (1979). Human factors experiments in designing interactive systems. Computer, December, 9-18.

Shneiderman, B. (1987). Designing the user interface: Strategies for effective human-computer interaction. Reading, Massachusetts: Addison Wesley.

Skinner, B.F. (1954). The science of learning and the art of teaching. Harvard Educational Review, 25, 86-97.

Spence, J.T. and Spence, K.W. (1966). The motivational components of manifest anxiety: Drive and drive stimuli. In C.D. Spielberger (Ed.) Anxiety and behavior. New York: Academic Press, 291-326.

Spielberger, C.D. (1962). The effects of manifest anxiety on the academic achievement of college students. Mental Hygiene, 46, 420-426.

Spielberger, C.D. (1966). Theory and research on anxiety. In C.D. Spielberger (Ed.), Anxiety and behavior. New York: Academic Press.

Spielberger, C.D. (1983). Manual for the State-Trait Anxiety Inventory STAI Form Y (Self-evaluation questionnaire). Palo Alto, California: Consulting Psychologists Press.

Spielberger, C.D. and Smith, L.H. (1966). Anxiety (drive), stress, and serial-position effects in serial-verbal learning. Journal of Experimental Psychology, 72, 589-595.

Spielberger, C.D., Auerbach, S.M., Wadsworth, A.P., Dunn, T.M., and Taulbee, E.S. (1973). Emotional reactions to surgery. Journal of Consulting and Clinical Psychology, 40, 33-38.

Spielberger, C.D., Gorsuch, R.L. and Lushene, R.E. (1970). Manual for the State-Trait Anxiety Inventory (Self-evaluation questionnaire). Palo Alto, California: Consulting Psychologists Press.

Spielberger, C.D., Vagg, P.R., Barker, L.R., Donham, G.W., and Westberry, L.G. (1980). The factor structure of the State-Trait Anxiety Inventory. In I.G. Sarason and C.D. Spielberger (Eds.), Stress and anxiety (Vol.7). New York: Hemisphere/Wiley.

Taylor, F.W. (1957). Psychology and the design of machines. American Psychologist, 12, 249-258.

Taylor, J.A. (1953). A personality scale of manifest anxiety. Journal of Abnormal and Social Psychology, 48, 285-290.

Taylor, R. (Ed.) (1967). IEEE Transactions on Human Factors in Electronics, March.

Wallach, M.A. (1962). Commentary: active-analytical vs. passive-global cognitive functioning. In S. Messick and J. Ross (eds) Measurement in personality and cognition. London: Wiley.

Webster's Ninth New Collegiate Dictionary. (1985). Springfield, Massachusetts: Merriam-Webster Inc.

Weinberg, G. (1971). The psychology of computer programming. New York: Van Nostrand Reinhold.

Wexley, K.N. (1984). Personnel training. Annual Review of Psychology, 35, 519-51.

Wexley, K.N. and Latham, G.P. (1981). Developing and training human resources in organizations, Glenview, Illinois: Scott, Foresman.

Whitbourne, S.K. and Weinstock, C.S. (1979). Adult development: The differentiation of experience, New York: Holt, Reinhart and Winston.

Winkle, L.W. and Mathews, W.M. (1982). Computer equity comes of age. Phi Delta Kappan, January, 314-315.

Witkin, H.A. (1950). Individual differences in ease of perception of embedded figures. Journal of Personality, 19, 1-15.

Witkin, H.A. (1977). Cognitive styles in the educational setting. New York University Education Quarterly, 8(3), 14-20.

Witkin, H.A. and Goodenough, D.R. (1977). Field dependence and interpersonal behavior. Psychological Bulletin, 84(4), 661-689.

Witkin, H.A. and Goodenough, D.R. (1981). Cognitive styles: Essence and origins, Psychological Issues Monograph 51, New York: International Universities Press.

Witkin, H.A., Dyk, R., Faterson, H.F., Goodenough, D.R. and Karp, S.A. (1962). Psychological differentiation, New York: John Wiley & Sons.

Witkin, H.A., Moore, C.A., Goodenough, D.R., and Cox, P.W. (1977). Field-dependent and field independent cognitive styles and their educational implications. Review of Educational Research, 47(1), 1-64.

Witkin, H.A., Oltman, P.K., Raskin, E., and Karp, S.A. (1971). A Manual for the Embedded Figures Test. Palo Alto, California: Consulting Psychologists Press.

Zanca, J. (1979). Math anxiety. Reprinted in E. Fennema (Ed.), Multiplying options and subtracting bias, Washington, D.C.: U.S. Department of Health, Education and Welfare, 16-21.

Zuboff, S. (1982). New worlds of computer-mediated work. Harvard Business Review, 60(5), 142.

Appendices

Appendix A
Training Manual

Master
Beverage Management System

A Complete Bar Management System

Developed by:
HMA Research and Services
Corvallis, Oregon

Master Beverage Management System

Introduction

Master Beverage Management System (MBMS) is a computerized management tool designed to provide beverage managers with full inventory and cost control over the bar operation. MBMS can be used in all size operations, from very small to very large.

The system has four modules:

S. System Management
I. Distilled Beverage Management
II. Wine Management
III. Beer Management

The four modules are fully integrated, however, each module may be used separately. You must start by setting up the system on Module S. System Management. Managers normally find it most useful to first implement Module I. Distilled Beverage Management, followed later by Modules II. Wine Management and III. Beer Management as they become more comfortable with the system.

Computer Hardware Requirements

MBMS is designed to operate on IBM Personal Computers or 100% compatible systems. Minimum system requirements to run one module are two floppy disk drives and 512K of memory. Running two or more modules requires a hard disk system. (Contact MBMS Customer Support for specific hardware requirements for your facility).

Licensing

Information in this document is subject to change without notice and does not represent a commitment on the part of HMA Research and Services. The software described in this document is furnished under a license agreement or nondisclosure agreement. The software may be used or copied only in accordance with the terms of the agreement.

Master Beverage Management System

System Organization

Module S. System Management

A. Set-up Initial Inventory
B. Set-up Initial Prices
C. Establish Par Stocks
D. Print Daily Usage Form
E. Print Liquor Order/Receiving Form
F. Enter Specialty Drink Recipes

Module I. Distilled Beverage Management

A. Liquor Receiving
B. Liquor Costs
C. Drink Category Pricing
D. Daily Usage
E. Daily Liquor Order Report
F. Daily Cost Analysis

Module II. Wine Management

A. Wine Receiving
B. Wine Cost
C. Wine Pricing
D. Daily Usage
E. Daily Wine Order Report
F. Daily Wine Cost Analysis

Module III. Beer Management

A. Beer Receiving
B. Beer Cost
C. Beer Pricing
D. Daily Usage
E. Daily Beer Order Report
F. Daily Beer Cost Analysis

Using This Manual

This manual is designed as both a reference manual and a tutorial for learning the system. If you are using the manual as a tutorial, then you will want to read the information and perform the tasks that are enclosed in boxes. For example, in the Change Liquor Costs section, to change a price you would complete the following exercise.

Exercise:

Using the Change Liquor Costs function, change the price of Jose Cuervo Gold Tequila from 11.55 to 12.00.

Note: Do not actually do this now, it is only shown as an example.

1. Press the **F2** key from the main menu to select Change Liquor Costs
2. Enter **35** followed by **Return** to select Jose Cuervo Gold Tequila.
3. Enter new price of **12.00** followed by **Return** (don't forget decimal point).
4. If you accidentally enter wrong price, simply repeat steps 2 and 3 with the correct price.
5. When finished, enter **Q** to stop entering changes.
6. When asked to Save or Discard Changes, enter **S** for save. System will update file and return you to main menu.

By reading the exercises, and then performing the tasks enclosed in the box, you will learn how to operate the MBMS system.

Module I: Distilled Beverage Management

Getting Started

Note: Go ahead and perform the following steps.

1. Remove the **Module I Systems Disk - Drive A** disk from its paper sleeve.
2. Open the door of Drive A.
3. Hold the disk by the label and slide it into Drive A, label side up. Do not force or bend the disk.
4. Close the drive door carefully.
5. Remove the **Module I Data Disk - Drive B** disk from its paper sleeve.
6. Open the door of Drive B.
7. Hold the disk by the label and slide it into Drive B, label side up.
8. Make sure the monitor is turned on, then turn on the computer. The light on the disk drive glows and you hear some whirling noises as the disk drive reads the disk.
9. After displaying information from your computer, eventually you will see the title screen for MBMS, followed by the main menu for Distilled Beverage Management.

Main Menu

There are six main functions in the Distilled Beverage Management Module. Each one is accessed by pressing the appropriate function key (F1 - F6) located on the left hand side of the keyboard. Key F7 is used to exit from the system. Key F10 hit at any time allows you to return to the main menu.

F1 - Enter Liquor Shipments to Inventory

This is where you record arrivals of liquor shipments as they are placed into inventory. The inventory will appear for entry in the same order as the Liquor Order/Receiving Form generated using Module I.

F2 - Change Liquor Costs

This function allows you to change prices of liquor. Costing of inventory is on a LIFO (last in first out) basis.

F3 - Change Drink Category Pricing

This function allows you to view and change prices charged for drinks by major drink category. (Pricing of specialty drinks and discounted drinks are made through Module S. System Management).

F4 - Enter Daily Liquor Usage

This is where you enter the total inventory used for the day. A daily usage form is generated in Module S. for bartenders to use in record their beginning and ending inventories.

F5 - Prepare Liquor Order Report

Based on inventory in stock, today's usage, and desired par stock levels, this function will generate an order report for liquor purchases.

F6 - View Cost Analysis

Based on inventory usage, inventory costs, and current drink prices, this function generates a report on cost and profit.

The manual will describe each of these in greater detail and provide practice exercises to execute to learn how to use the system.

F1 - Enter Liquor Shipments to Inventory

This function allows you to post liquor inventory to the system as it arrives. It is easiest to enter inventory using the Liquor Order and Receiving Form generated using module 1.

Exercise:

Post the following number of bottles of each of the following to inventory:

5 Wild Turkey
9 Kahlua
7 Grand Marnier
4 Beefeaters
3 Cutty Sark

From code numbers the system automatically knows the size of bottle for each and will make the conversion for liters to ounces for calculating costs.

1. From the main menu press the **F1** key to select Enter Liquor Shipments to Inventory
2. Enter **2**, the item code for Wild Turkey in response to "Which Item to Add Inventory To (1-40)? " followed by pressing the **Return** key.
3. Enter **5**, the number of bottles, in response to "Number of Units? " followed by pressing the **Return** key. 5 will appear in the Add Inventory column following Wild Turkey. Repeat these steps for the other inventory items.
4. When you have completed all the entry, press the **Return** key in response to "Which Item to Add Inventory To?".
5. If you want to save the changes (which you should), enter **S** for save followed by pressing the **Return** key in response to "Do You Want to Save or Ignore Changes?". If you made errors and wish to start over, enter **I** for ignore changes followed by **Return**. You will return to the main menu and the changes will not be recorded.

F2 - Change Liquor Costs

This function allows you to change the cost charged to us for liquor purchased. MBMS is based on a LIFO System so that liquor is always priced at the most current price.

Exercise:

Change the prices of the following items to the ones shown:

15.00	Cutty Sark
12.00	Popov Vodka
12.00	Jack Daniels
16.50	Jim Beam

1. From the main menu press the **F2** key to select Change Liquor Costs.
2. Enter **31**, the item code for Cutty Sark in response to "Which Item to Change Cost Of (1-40)? " followed by pressing the **Return** key.
3. Enter **15.00**, the new cost, in response to "New Cost? " followed by pressing the **Return** key. 15.00 will appear in the Cost column following Cutty Sark. Repeat these steps for the other price changes.
4. When you have completed all the entries, press the **Return** key in response to "Which Item to Change Cost Of?"
5. If you want to save the changes (which you should), enter **S** for save followed by pressing the **Return** key in response to "Do You Want to Save or Ignore Changes (S or I)?". If you made errors and wish to start over, enter **I** for ignore changes followed by **Return**. You will return to the main menu and the changes will not be recorded.

F3 - Change Drink Category Prices

This function allows you to establish standard drink prices for each drink category: well, call, premium, and special. (Specialty drinks and mixed drink prices are managed through Module S.)

Exercise:

Change the price of well drinks to $2.85 and the price of premium drinks to $4.15.

1. From the main menu press the **F3** key to select Change Drink Category Prices.
2. Enter **1**, the item code for Well Drinks, in response to "Which Item Do You Wish to Change (1-4)? " followed by pressing the **Return** key.
3. Enter **2.85**, the new price, in response to "New Price? " followed by pressing the **Return** key. 2.85 will appear in the Price column following Well Drinks. Repeat these steps for the other price changes.
4. When you have completed all the entries, press the **Return** key in response to "Which Item Do You Wish to Change?"
5. If you want to save the changes (which you should), enter **S** for save followed by pressing the **Return** key in response to "Do You Want to Save or Ignore Changes (S or I)?". If you made errors and wish to start over, enter **I** for ignore changes followed by **Return**. You will return to the main menu and the changes will not be recorded.

F4 - Enter Daily Liquor Usage

This function is where you record liquor used during the day. At the beginning of each day, and perhaps each shift, the bartender should take an opening inventory. This system is designed so that all figures are recorded in 1/10ths of liters. In measuring the bar, the bartender should use a graduated bottle rule which measures the liquid volume in 1/10 liters. The difference between beginning and ending inventory is the usage (use form generated using Module S).

Usage figures are subtracted from inventory to provide a perpetual inventory, and are also used to determine daily sales and costs.

Exercise:

Enter the following sales figures for the bar:

2.2	Jim Beam
1.4	Kahlua
3.6	Beefeater
5.5	Jack Daniel

1. From the main menu press the **F4** key to select Enter Daily Liquor Usage.

2. Enter **1**, the item code for Jim Beam in response to "Which Item to Record Usage (1-40)? " followed by pressing the **Return** key.

3. Enter **2.2**, the usage in liters, in response to "Liters Used (In Tenths)?" followed by pressing the **Return** key. 2.2 will appear in the Used column following Cutty Sark. Repeat these steps for the other items of usage. An Error Message will occur if you report usage greater than available inventory.

4. When you have completed all the entries, press the **Return** key in response to "Which Item to Record Usage?"

5. If you want to save the changes (which you should), enter **S** for save followed by pressing the **Return** key in response to "Do You Want to Save or Ignore Changes (S or I)?". If you made errors and wish to start over, enter **I** for ignore changes followed by **Return**. You will return to the main menu and the changes will not be recorded.

F5 - Prepare Liquor Order Report

This function prepares a liquor order. The order is calculated by first determining remaining inventory: beginning inventory plus purchases less usage. It then reads the desired Par Stock for the bar and calculates the required order of standard bottles to return the bar to Par.

Exercise:

Look at the Liquor Order Report.

1. From the main menu press the F5 key to select Prepare Liquor Order Report.
2. To see the second page, press any key.
3. To return to the main menu, press any key.

F6 - View Cost Analysis

The Cost Analysis Report informs management of what revenue, cost, and pour cost percentages should be for actual usage, broken down by drink category.

Exercise:

Look at Cost Analysis Report.

1. From the main menu press the F6 key to select View Cost Analysis.
2. To return to the main menu, press any key.

F7 - Exit System

This function exits the MBMS system, and records all changes made to the permanent files. Once you press F7, you are given one more chance to return to the system. Answering Y to the return question exits you from the system.

Appendix B
Demographic Survey

Name_________________________________

1. Did you gain experience using computers in high school?
   Yes___ No___

2. Have you completed BA 131 or its equivalent?
   Yes___ No___

3. Have you taken any other college course(s) which <u>required</u> you to use a computer?
   Yes___ No___

   If Yes, please specify course:________________________

4. Other than in high school or college, have you received other formal training in using computers?
   Yes___ No___

   If Yes, please describe:______________________________

5. Which of the following types of programs have you had experience with on a personal computer:
   ___ Word Processing (like WordPerfect, Word, Applewriter)
   ___ Spreadsheet (like Lotus 1-2-3, Visicalc)
   ___ Database Manager (like DBaseII, Reflex)
   ___ Writing programs in BASIC
   ___ Writing programs in FORTRAN

6. Do you now make use of a personal computer to complete papers or assignments?
   Yes___ No___

7. Have you ever been required to use a computer as part of a paying job?
   Yes___ No___
   If Yes, please describe where and type of computer activity:

8. Generally, how would you rate your computer ability?
   ___ Illiterate, know little or nothing about computers
   ___ Hacker, I use one occassionally but not by choice
   ___ Average, I'm able to use a computer but nothing fancy
   ___ Computer Literate, am able to work well with some programs
   ___ Expert, I know quite a lot about computers and their use

9. Your age: _______ years

10. Male___ Female___

Appendix C
Training Instructions for Instructor

INSTRUCTIONS FOR COMPUTER TRAINING SESSION

Introduction

The system you are working on today has been specially designed for testing. You will be asked to perform the following three major tasks:

1. Complete training on how to use one of the modules in the system.

2. Complete a survey on the computer to measure your response to the system.

3. Complete a series of representative tasks using the system.

Before Your Start

Before you start, you should check to see that you have:

1. "Module I System Disk - Drive A" floppy disk

2. "Module I Data Disk - Drive B" floppy disk

3. Section from Master Beverage Management System Manual

4. Packet of representative tasks to perform

Instructions for MBT Group

Open the manual and begin following instructions. Once you have completed the training section, the computer will automatically give you the survey. Once you have completed the survey, the computer will automatically return you to the system so you can complete the assigned tasks as noted in the packet.

Try to complete this training on your own. However, if you get stuck or need assistance, raise your hand and the instructor will assist you.

Instructions for IBT Group

We will now begin the training. If you have questions as we go, please ask them. (Present training as closely as possible to way it is presented in manual.)

Appendix D
Practice Exercises

PRACTICE EXERCISES

Attached are some representative forms from industry. Now that you have completed training on the system, complete the following set of activities. Try to complete the list of tasks as efficiently as possible.

1. From the attached Liquor Store Order/Receiving Form, enter the shipment received into inventory.

2. From the attached Liquor Store Order/Receiving Form, make the four changes in liquor costs noted in the price column.

3. From the attached Daily Liquor Usage Report, record the day's usage in the system.

4. Change the price of well drinks from $2.25 to $2.35.

5. Change the price of call drinks from $3.50 to $3.25.

6. View the Liquor Order Report for the next day.

7. View the Cost Analysis for the day.

8. Exit the system.

LIQUOR ORDER AND RECEIVING FORM

Category	Code No.	Brand Name	Size Liters	Price	Order Qty
BOURBON	140	JIM BEAM	1.75	~~17.05~~ 16.50	3
BOURBON	6037	WILD TURKEY	0.75	15.05	
BRANDY	423	CRIBARI	1.75	15.25	
BRANDY	2025	PRESINDENTE	0.75	12.10	
CANADIAN	304	CANADIAN CLUB	0.75	11.25	
CANADIAN	311	SEAGRAMS CR ROYAL	0.75	18.10	
CANADIAN	324	WESTERN CANADIAN	1.75	~~13.85~~ 14.00	
COGNAC	439	COURVOISIER V S	0.75	21.60	
C/ALMOND	959	AMARETTO SARONNO	0.75	19.25	6
C/ALMOND	960	GARNIER DI AMORE	0.75	7.70	
C/CACAO	984	CHATEAUX	0.75	5.95	
C/COFFEE	918	KAHLUA	0.75	14.75	3
C/COFFEE	995	MONARCH	0.75	6.00	
C/CREAM	943	BAILEY IRISH	0.75	18.40	4
C/CREAM	1033	ODARBY IRISH	0.75	10.35	4
C/ITALIAN	926	FLORENTINO	0.75	7.95	
C/ITALIAN	919	GALLIANO	0.75	21.25	
C/MENTHE	2135	BOLS	0.75	~~7.50~~ 6.95	
C/NUT	969	FRANGELICO	0.75	18.90	
C/ORANGE	917	COINTREAU	0.75	27.95	
C/ORANGE	6095	GRAND MARNIER	0.75	30.45	
C/ORANGE	1060	UTU ORANGE	0.75	13.90	
C/OTHER	903	SOUTHERN COMFORT	0.75	8.55	
C/SCHNAPPS	1093	SCHRANCKS PEPP	0.75	5.15	
C/SCOTCH	914	DRAMBUIE	0.75	22.85	3
GIN	532	BEEFEATER	0.75	13.65	12
GIN	523	BOORDS	1.75	12.05	
IRISH	389	MURPHYS	0.75	12.75	
RUM	460	BACARDI	0.75	7.70	3
RUM	490	POTTERS	1.75	11.75	6
SCOTCH	346	CUTTY SARK	0.75	14.70	
SCOTCH	388	SCORESBY	1.75	17.80	6
SLOE GIN	551	MR. BOSTON	0.75	6.40	
TEQUILLA	905	ACAPULCO	1.75	12.75	4
TEQUILLA	902	JOSE CUERVO GOLD	0.75	~~11.55~~ 12.00	6
TRIPLE SEC	1056	MONARCH	0.75	4.95	
VODKA	677	POPOV	1.75	12.20	12
VODKA	697	STOLICHNAYA	0.75	13.80	
WHISKEY	146	JACK DANIEL	0.75	12.10	3
WHISKEY	221	POTTERS SPECIAL	1.75	12.55	6

DAILY LIQUOR USAGE FORM

Master Beverage Management System
(Enter all figures in 10ths of Liters)

		Start	End	Usage
BOURBON	JIM BEAM	2.0	1.3	0.7
BOURBON	WILD TURKEY	2.4	2.4	
BRANDY	CRIBARI	5.6	4.4	1.2
BRANDY	PRESINDENTE	0.7	0.7	
CANADIAN	CANADIAN CLUB	4.0	2.7	1.3
CANADIAN	SEAGRAMS CR ROYAL	2.3	1.8	0.5
CANADIAN	WESTERN CANADIAN	3.0	2.2	0.8
COGNAC	COURVOISIER V S	1.4	1.4	
C/ALMOND	AMARETTO SARONNO	5.6	3.3	2.3
C/ALMOND	GARNIER DI AMORE	4.1	2.1	2.0
C/CACAO	CHATEAUX	2.7	2.7	
C/COFFEE	KAHLUA	4.3	2.0	2.3
C/COFFEE	MONARCH	1.9	1.9	
C/CREAM	BAILEY IRISH	7.7	4.5	3.2
C/CREAM	ODARBY IRISH	4.7	0.8	3.9
C/ITALIAN	FLORENTINO	1.9	1.8	0.1
C/ITALIAN	GALLIANO	2.3	1.9	0.4
C/MENTHE	BOLS	2.3	2.2	0.1
C/NUT	FRANGELICO	1.6	1.6	
C/ORANGE	COINTREAU	1.9	1.9	
C/ORANGE	GRAND MARNIER	3.3	2.0	1.3
C/ORANGE	UTU ORANGE	4.7	3.8	0.9
C/OTHER	SOUTHERN COMFORT	2.1	2.1	
C/SCHNAPPS	SCHRANCKS PEPP	1.6	1.6	
C/SCOTCH	DRAMBUIE	1.4	1.4	
GIN	BEEFEATER	7.0	2.5	4.5
GIN	BOORDS	12.3	6.3	6.0
IRISH	MURPHYS	3.7	3.7	
RUM	BACARDI	4.6	2.1	2.5
RUM	POTTERS	9.6	4.1	5.5
SCOTCH	CUTTY SARK	4.0	1.3	2.7
SCOTCH	SCORESBY	10.3	5.5	4.8
SLOE GIN	MR. BOSTON	1.0	1.0	
TEQUILLA	ACAPULCO	4.3	2.6	1.7
TEQUILLA	JOSE CUERVO GOLD	7.8	3.0	4.8
TRIPLE SEC	MONARCH	3.0	2.0	1.0
VODKA	POPOV	15.8	5.8	10.0
VODKA	STOLICHNAYA	1.2	1.2	
WHISKEY	JACK DANIEL	4.0	0.2	3.8
WHISKEY	POTTERS SPECIAL	9.1	3.1	6.0

↑

RECORD THESE
NUMBERS

Appendix E
Example of Execution Error Scoring

Solution Key

Item No.	End Price	End	Add To	Take From	New Price
1	16.5	15.8	3	0.7	16.5
2	15.05	4	0	0	0
3	15.25	4.8	0	1.2	0
4	12.1	4	0	0	0
5	11.25	6.7	0	1.3	0
6	18.1	3.5	0	0.5	0
7	14	5.2	0	0.8	14
8	21.6	3	0	0	0
9	19.25	15.7	6	2.3	0
10	7.7	10	0	2	0
11	5.95	4	0	0	0
12	14.75	11.2	3	2.3	0
13	6	6	0	0	0
14	18.4	8.8	4	3.2	0
15	10.35	8.1	4	3.9	0
16	7.95	2.9	0	0.1	0
17	21.25	4.6	0	0.4	0
18	6.95	5.9	0	0.1	6.95
19	18.9	2	0	0	0
20	27.95	3	0	0	0
21	30.45	2.7	0	1.3	0
22	13.9	3.1	0	0.9	0
23	8.55	2	0	0	0
24	5.15	6	0	0	0
25	22.85	6.5	3	0	0
26	13.65	19.5	12	4.5	0
27	12.05	0	0	6	0
28	12.75	6	0	0	0
29	7.7	14	3	2.5	0
30	11.75	21.5	6	5.5	0
31	14.7	9.3	0	2.7	0
32	17.8	22.2	6	4.8	0
33	6.4	4	0	0	0
34	12.75	18.3	4	1.7	0
35	12	12.2	6	4.8	12
36	4.95	5	0	1	0
37	12.2	38	12	10	0
38	13.8	4	0	0	0
39	12.1	6.7	3	3.8	0
40	12.55	21	6	6	0

Subject 106 Results

Item No.	End Price	End	Add To	Take From	New Price
1	16.5	15.8	3	0.7	16.5
2	15.1	4	0	0	0
3	15.3	4.8	0	1.2	0
4	12.1	4	0	0	0
5	11.3	6.7	0	36	0
6	18.1	3.5	0	0.5	0
7	14	5.2	0	0.8	14
8	21.6	3	0	0	0
9	19.3	15.7	6	2.3	0
10	7.7	10	0	0	0
11	5.95	4	0	0	0
12	14.8	11.2	3	0	0
13	6	6	0	0	0
14	18.4	8.8	4	3.2	0
15	10.3	8.1	4	3.9	0
16	7.95	2.9	0	0.1	0
17	21.3	4.6	0	0.4	0
18	6.95	5.9	0	0.1	6.95
19	18.9	2	0	0	0
20	27.9	3	0	0	0
21	30.4	2.7	0	1.3	0
22	13.9	3.1	0	0.9	0
23	8.55	2	0	0	0
24	5.15	6	3	0	0
25	22.9	6.5	0	4.5	0
26	13.7	19.5	12	4.5	0
27	12.1	0	0	6	0
28	12.8	6	0	2.5	0
29	7.7	14	3	0	0
30	11.8	21.5	6	5.5	0
31	14.7	9.3	0	2.7	0
32	17.8	22.2	6	4.8	0
33	6.4	4	0	0	0
34	12.8	18.3	4	1.7	0
35	12	12.2	6	4.8	12
36	4.95	5	12	1	0
37	12.2	38	0	5	0
38	13.8	4	0	0	0
39	12.1	6.7	3	3.8	0
40	12.6	21	6	6	0

Errors Circled (11)

Appendix F
Data From Study

<u>Key to Data Table</u>

Column

A - Subject Identification Number
B - Treatment (1=MBT, 2=IBT)

Items C - M Coded 1=Yes 2=No

C - Computer Experience In Highschool
D - Completed College Course on Computers
E - Other College Courses Requiring Computer Use
F - Formal Training On Computers Outside School
G - Experience with Word Processing
H - Experience with Spreadsheets
I - Experience with Database Manager
J - Experience Programming in BASIC
K - Experience Programming in Fortran
L - Use Computer in Preparing Class Assignments
M - Use Computer as Part of a Paying Job

N - General Rating of Computer Ability
(1=Illiterate, 2=Hacker, 3=Average, 4=Literate, 5=Expert)

O - Age (in years)
P - Sex (1=Male, 2=Female)

Q - Score on GEFT Part 1
R - Score on GEFT Part 2
S - Total Score on GEFT
T - Score on T-Anxiety Scale
U - Score on S-Anxiety Scale

V - Training Time (in minutes)
W - Execution Time (in minutes)
X - Execution Errors (number)

Study Data

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	A
101	1	1	1	2	2	1	2	2	1	2	1	1	3	21	2	7	9	16	36	21	10.83	16.27	0	101
102	2	1	1	1	1	1	1	1	1	2	1	1	5	23	2	2	1	3	32	22	14.35	11.63	4	102
103	2	1	1	2	2	1	1	2	1	2	1	2	3	19	1	7	8	15	29	28	13.82	12.37	0	103
104	2	2	2	2	1	1	1	1	1	2	2	1	4	27	2	3	5	8	33	21	13.88	11.92	0	104
105	2	1	1	1	1	1	2	2	1	2	1	2	3	20	2	1	1	2	35	38	13.88	13.17	5	105
106	2	2	1	2	2	1	2	2	1	2	2	2	2	26	1	3	8	11	44	39	13.90	15.13	11	106
107	2	1	1	1	2	1	1	2	1	2	2	1	3	23	2	7	9	16	33	23	13.80	9.57	0	107
108	2	1	1	1	1	1	2	2	1	2	2	1	3	20	2	9	9	18	35	23	13.22	13.97	0	108
109	1	1	1	1	2	1	2	1	1	1	1	2	3	20	1	2	3	5	24	22	11.05	17.50	4	109
110	1	1	1	2	1	1	2	2	1	2	1	1	4	20	1	5	7	12	41	30	12.60	13.95	0	110
111	1	2	2	1	2	1	2	2	1	1	1	2	3	42	1	4	5	9	27	29	16.33	16.30	6	111
112	1	1	1	1	2	1	2	2	1	2	2	1	3	20	2	9	9	18	36	24	12.37	14.15	0	112
113	1	2	1	1	2	2	2	2	1	2	2	2	1	21	1	7	8	15	36	34	12.05	11.03	0	113
114	1	1	1	2	2	1	1	2	1	2	1	1	3	20	1	8	9	17	34	23	16.22	18.60	0	114
115	1	1	1	1	2	1	1	1	1	2	1	2	4	18	1	3	9	12	38	29	11.30	14.58	0	115
116	2	1	2	2	1	2	2	2	1	2	2	1	3	18	1	7	8	15	50	36	15.62	15.08	4	116
117	2	2	1	2	2	2	2	2	2	2	2	2	1	25	1	9	9	18	34	28	15.28	13.73	0	117
118	2	2	1	1	2	1	1	2	1	2	1	2	3	30	1	5	6	11	26	20	15.75	14.02	0	118
119	2	1	2	2	1	2	2	2	1	2	2	2	3	19	1	6	4	10	35	35	15.67	7.12	27	119
120	2	1	1	2	2	2	2	2	1	2	2	1	2	20	2	4	4	8	27	21	15.07	13.52	2	120
121	2	1	2	1	2	1	1	2	2	2	2	2	3	19	2	5	6	11	28	30	15.25	10.97	0	121
122	2	2	1	1	2	1	2	2	1	2	1	2	3	22	1	5	6	11	36	22	12.92	16.38	0	122
123	1	1	2	2	2	1	2	2	1	2	2	1	2	18	1	4	6	10	35	34	8.07	16.60	2	123
124	1	2	1	2	2	2	2	2	1	2	2	2	1	20	2	2	3	5	39	53	17.27	15.80	3	124
125	1	1	1	2	2	1	1	1	1	2	2	2	3	20	2	6	8	14	36	34	8.37	11.23	0	125
126	1	1	1	2	2	1	1	1	1	2	1	2	4	18	1	8	8	16	24	26	11.08	11.90	0	126
127	1	2	1	1	1	1	2	2	1	2	1	1	3	43	2	6	9	15	24	25	11.58	12.18	0	127
128	1	1	1	2	2	1	1	2	1	2	1	2	3	19	2	1	2	3	34	23	11.75	13.32	2	128
129	1	2	2	2	2	2	2	2	2	2	1	1	1	22	2	7	8	15	34	30	18.27	15.65	0	129
130	1	1	2	2	2	2	2	2	1	2	2	2	2	18	1	3	4	7	31	39	10.88	17.07	0	130
131	1	1	1	1	2	2	1	2	2	2	2	2	2	21	2	7	6	13	41	37	13.17	11.30	0	131
132	1	1	2	2	2	2	2	2	2	2	2	1	1	20	2	6	8	14	39	24	19.52	6.48	0	132
133	1	2	1	1	2	2	2	2	1	2	2	2	1	20	2	9	9	18	39	24	9.63	12.57	0	133
134	1	2	1	1	2	2	2	2	1	2	2	1	2	23	2	3	8	11	30	26	12.80	11.25	0	134
135	1	1	2	2	2	1	2	2	1	2	2	2	3	19	1	5	8	13	38	27	9.45	12.05	1	135
136	1	1	1	1	1	1	1	1	1	2	2	1	5	18	1	7	9	16	54	28	8.77	10.50	0	136

Study Data

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	A
137	1	2	1	2	2	2	2	2	1	2	2	2	1	26	2	3	4	7	35	25	12.73	15.42	0	137
138	1	1	1	2	2	1	1	1	1	2	1	2	3	21	2	4	1	5	41	21	10.98	16.55	2	138
139	1	1	2	1	2	2	2	2	1	2	2	2	3	21	1	7	9	16	27	25	13.90	14.05	5	139
140	1	1	1	2	2	1	1	1	1	2	1	2	3	19	2	2	7	9	27	28	10.77	14.58	0	140
141	1	1	1	1	2	1	1	2	1	2	1	2	3	21	1	2	6	8	42	39	14.30	15.48	0	141
142	1	1	1	2	2	1	1	1	1	2	1	2	3	18	2	3	8	11	53	38	12.57	14.65	0	142
143	2	1	1	1	2	1	1	1	1	2	2	2	3	20	2	6	9	15	42	30	12.83	11.10	0	143
144	2	1	1	2	2	1	1	1	1	2	1	1	4	20	2	3	9	12	43	30	12.90	12.28	1	144
145	2	1	1	1	2	1	1	2	2	2	1	1	3	21	2	8	9	17	28	32	12.87	11.23	0	145
146	2	2	2	1	2	2	2	2	2	2	2	2	1	37	1	8	9	17	34	35	12.88	11.50	1	146
147	2	2	1	1	2	1	1	1	1	2	2	1	3	20	2	4	6	10	52	26	12.87	10.50	1	147
148	2	2	1	1	2	1	1	1	1	2	2	2	2	19	2	8	9	17	35	33	13.30	9.87	2	148
149	2	1	1	1	2	1	1	2	1	2	2	1	3	19	2	4	5	9	43	52	13.05	15.65	1	149
150	2	1	2	2	1	1	2	2	2	2	1	2	4	19	2	6	9	15	29	20	12.97	12.42	0	150
151	2	1	1	1	1	1	2	2	1	2	1	1	3	21	1	8	8	16	36	22	12.62	12.95	0	151
152	2	1	1	1	1	1	2	2	1	2	2	1	3	20	2	4	6	10	34	31	12.50	11.68	0	152
153	2	1	1	2	2	1	2	2	2	2	1	2	3	19	2	6	7	13	27	23	12.55	11.48	0	153
154	1	2	1	1	2	1	1	2	1	2	2	2	3	20	2	8	5	13	31	21	12.53	10.08	0	154
155	2	2	2	2	1	2	2	2	2	2	2	1	3	18	2	9	9	18	36	34	12.52	11.73	1	155
156	2	2	1	1	1	1	2	1	1	2	2	1	4	22	2	3	5	8	43	32	12.97	16.87	1	156
157	2	1	1	2	2	1	1	1	1	2	2	1	3	22	1	8	9	17	30	25	14.28	12.78	55	157
158	1	2	2	2	2	2	2	2	2	2	2	2	2	19	2	2	8	10	29	23	13.53	13.40	0	158
159	2	1	1	1	1	1	1	1	1	1	2	1	4	20	1	9	9	18	31	31	14.27	10.17	0	159
160	2	2	1	1	2	1	1	2	1	2	1	1	3	25	1	2	5	7	31	28	14.28	11.92	2	160
161	2	1	1	2	2	1	1	1	1	2	1	1	3	18	2	2	4	6	30	20	14.25	8.88	0	161
162	2	2	1	2	2	1	1	1	2	2	1	2	3	22	2	0	2	2	36	20	14.25	17.28	0	162
163	2	2	1	1	2	1	2	2	2	2	2	2	1	23	1	7	7	14	32	38	12.78	11.12	0	163
164	1	2	2	2	2	2	2	2	1	2	2	2	1	17	2	5	9	14	36	20	10.77	12.68	46	164
165	1	2	1	1	2	2	1	2	1	2	2	2	2	22	2	8	9	17	48	34	12.47	13.12	0	165
166	2	1	1	1	2	1	1	2	1	2	2	2	3	20	2	9	9	18	38	27	12.72	13.07	0	166
167	1	1	1	1	2	1	1	2	1	1	1	1	4	25	1	3	6	9	33	30	14.97	12.27	1	167
168	2	1	1	1	2	1	2	2	1	2	1	2	3	21	2	8	9	17	38	25	12.73	11.63	0	168
169	2	1	1	1	2	1	2	2	1	2	2	2	3	19	2	8	9	17	33	20	12.70	11.45	0	169
170	2	2	2	2	1	2	2	2	2	2	2	1	2	22	2	6	8	14	34	47	12.73	10.38	0	170
171	1	2	1	1	2	2	1	2	1	2	2	2	2	21	2	6	9	15	39	34	9.63	14.62	2	171
172	1	2	1	2	2	2	2	2	1	2	1	2	3	21	2	7	9	16	33	26	10.15	14.82	3	172

Appendix G

Program Code for Beverage Management System

Master Beverage Management System
Program Code Listing

```
90 OPEN "B:TIMEREC.DAT" FOR OUTPUT AS #3
91 PRINT #3,TIME$,0
1000 '=============================MAIN PROGRAM CONTROL=====================
1010 GOSUB 5000 '                                  DISABLE FUNCTION KEYS
1020 GOSUB 6110 '                                  DISPLAY TITLE MENU
1030 GOSUB 5060 '                                  ENTER INVENTORY INTO MEMORY
1040 GOSUB 6240 '                                  DISPLAY MAIN MENU
1050 FOR X=1 TO 7:KEY (X) ON:NEXT X
1055 KEY (10) ON
1056 ON KEY (10) GOSUB 9000
1060 ON KEY (1) GOSUB 5280
1070 ON KEY (2) GOSUB 5660
1080 ON KEY (3) GOSUB 7000
1090 ON KEY (4) GOSUB 9280
1100 ON KEY (7) GOSUB 10000
1110 ON KEY (5) GOSUB 12000
1120 ON KEY (6) GOSUB 13000
4990 GOTO 1060
4999 CLOSE:END
5000 '=============================DISCONNECT FUNCTION KEYS=================
5010 CLS
5020 KEY OFF
5030 FOR X=1 TO 10:KEY X,"":NEXT X
5040 FOR X=1 TO 10:KEY (X) OFF:NEXT X
5050 RETURN
5060 '=============================LOAD INVENTORY INTO MEMORY===============
5090 DIM CAT$(50),TYP$(50),COD(50),INV(50), ADDINV(50), SUBINV(50)
5100 DIM NAM$(50),SIZ(50),PRC(50),ITM(50), PAR(50), NEWPRC(50)
5110 OPEN "INVENTOR.PRN" FOR INPUT AS #1
5120 COUNT = 0
5130 IF EOF (1) THEN 5250
5140 LINE INPUT #1, A$
5150 COUNT=COUNT + 1
5160 ITM(COUNT)=VAL(LEFT$(A$,3))
5170 CAT$(COUNT)=MID$(A$,4,10)
5180 TYP$(COUNT)=MID$(A$,14,1)
5190 COD(COUNT)=VAL(MID$(A$,15,5))
5200 NAM$(COUNT)=MID$(A$,20,17)
5210 SIZ(COUNT)=VAL(MID$(A$,37,5))
5220 PRC(COUNT)=VAL(MID$(A$,42,6))
5230 INV(COUNT)=VAL(MID$(A$,48,4))
5235 PAR(COUNT)=VAL(MID$(A$,52,4))
5240 GOTO 5130
5250 BARTOT=COUNT
```

```
5260 CLOSE #1
5261 OPEN "DRPRICE.DAT" FOR INPUT AS #2
5262 FOR X=1 TO 4
5263 INPUT #2,DRPR(X)
5264 NEXT X
5265 CLOSE #2
5270 RETURN
5280 '=======RECORD LIQUOR ORDER=======DISPLAY INVENTORY=====================
5281 PRINT #3,TIME$,1
5290 CLS
5300 LOCATE 2,1:COLOR 0,7:PRINT "ITM CATEGORY   BRAND                       ":COLOR 7,0:
5310 LOCATE 2,41:COLOR 0,7:PRINT "ITM CATEGORY   BRAND                       ":COLOR 7,0:
5320 FOR X=1 TO 20
5330 LOCATE X+2,1:PRINT USING "##. ";ITM(X);
5340 LOCATE X+2,5:PRINT CAT$(X);
5350 LOCATE X+2,16:PRINT NAM$(X);
5360 LOCATE X+2,41:PRINT USING "##. ";ITM(X+20);
5370 LOCATE X+2,45:PRINT CAT$(X+20);
5380 LOCATE X+2,56:PRINT NAM$(X+20);
5390 NEXT X
5400 '==========================ENTER INVENTORY AMOUNTS======================
5420 LOCATE 2,33:COLOR 0,7:PRINT "ADD INV";:COLOR 7,0
5430 LOCATE 2,73:COLOR 0,7:PRINT "ADD INV";:COLOR 7,0
5440 LOCATE 24,2:PRINT   "WHICH ITEM TO ADD INVENTORY TO (1-40)? ";
5450 LINE INPUT;X$
5460 IF X$="" THEN 5570
5470 X=VAL(X$)
5480 IF X<1 OR X>40 THEN 5560
5490 LOCATE 24,55:PRINT;"NUMBER OF UNITS? ";
5500 LINE INPUT;R$
5510 IF R$="" THEN 5560
5520 ADDINV(X)=VAL(R$)
5530 IF ADDINV(X)<0 OR ADDINV(X)>25 THEN 5560
5540 IF X<21 THEN LOCATE X+2,33:PRINT USING "  ##";ADDINV(X);
5550 IF X>20 THEN LOCATE X-18,73:PRINT USING "  ##";ADDINV(X);
5560 LOCATE 24,5:PRINT SPC(75);:GOTO 5440
5570 LOCATE 24,1:PRINT SPC(75);
5580 LOCATE 24,5:PRINT "DO YOU WANT TO SAVE OR IGNORE CHANGES (S OR I)? ";
5590 R$=INPUT$(1)
5600 IF R$="I" OR R$="i" THEN 5650
5610 IF R$="S" OR R$="s" THEN 5630
5620 GOTO 5570
5630 FOR X=1 TO 40:INV(X)=INV(X)+ADDINV(X)*SIZ(X)
5640 NEXT X
5650 CLS:RETURN 1040
5660 '===============================CHANGE LIQUOR PRICES===================
5661 PRINT #3,TIME$,2
5670 CLS
5680 LOCATE 2,1:COLOR 0,7:PRINT "ITM CATEGORY   BRAND                       ":COLOR 7,0:
5690 LOCATE 2,41:COLOR 0,7:PRINT "ITM CATEGORY   BRAND                       ":COLOR 7,0:
5700 FOR X=1 TO 20
5710 LOCATE X+2,1:PRINT USING "##. ";ITM(X);
5720 LOCATE X+2,5:PRINT CAT$(X);
5730 LOCATE X+2,16:PRINT NAM$(X);
```

```
5740 LOCATE X+2,41:PRINT USING "##. ";ITM(X+20);
5750 LOCATE X+2,45:PRINT CAT$(X+20);
5760 LOCATE X+2,56:PRINT NAM$(X+20);
5770 NEXT X
5790 LOCATE 2,34:COLOR 0,7:PRINT " COST";:COLOR 7,0
5800 LOCATE 2,74:COLOR 0,7:PRINT " COST";:COLOR 7,0
5810 FOR X=1 TO 20
5820 LOCATE X+2,34:PRINT USING "##.##";PRC(X);
5830 NEXT X
5840 FOR X=21 TO 40
5850 LOCATE X-18,74:PRINT USING "##.##";PRC(X);
5860 NEXT X
5870 LOCATE 24,2:PRINT   "WHICH ITEM TO CHANGE COST OF (1-40)? ";
5880 LINE INPUT;X$
5890 IF X$="" THEN 6020
5900 X=VAL(X$)
5910 IF X<1 OR X>40 THEN 6010
5920 LOCATE 24,55:PRINT;"NEW COST? ";
5930 LINE INPUT;R$
5940 IF R$="" THEN 6010
5950 NEWPRC(X)=VAL(R$)
5960 IF NEWPRC(X)<0 OR NEWPRC(X)>75 THEN 6010
5970 IF X<21 THEN LOCATE X+2,32:PRINT SPC(7)
5980 IF X<21 THEN LOCATE X+2,32:PRINT USING "  ##.##";NEWPRC(X);
5990 IF X>20 THEN LOCATE X-18,72:PRINT SPC(7);
6000 IF X>20 THEN LOCATE X-18,72:PRINT USING "  ##.##";NEWPRC(X);
6010 LOCATE 24,5:PRINT SPC(75);:GOTO 5870
6020 LOCATE 24,1:PRINT SPC(75);
6030 LOCATE 24,5:PRINT "DO YOU WANT TO SAVE OR IGNORE CHANGES (S OR I)? ";
6040 R$=INPUT$(1)
6050 IF R$="I" OR R$="i" THEN 6100
6060 IF R$="S" OR R$="s" THEN 6080
6070 GOTO 6020
6080 FOR X=1 TO 40
6090 IF NEWPRC(X)>0 THEN PRC(X)=NEWPRC(X)
6095 NEXT X
6100 CLS:RETURN 1040
6110 '==============================TITLE MENU==============================
6120 CLS
6130 LOCATE 2,17:PRINT "****************************************"
6140 LOCATE 3,17:PRINT "*  MASTER BEVERAGE MANAGEMENT SYSTEM  *"
6150 LOCATE 4,17:PRINT "****************************************"
6160 LOCATE 10,20:PRINT "        Developed by"
6170 LOCATE 12,20:PRINT "  HMA Research and Services"
6180 LOCATE 13,24:PRINT "  Corvallis, Oregon"
6190 LOCATE 17,20:PRINT "      Copyrighted 1987"
6200 LOCATE 20,10:PRINT "This software is furnished under a license agreement"
6210 LOCATE 21,5:PRINT "Software may not be copied or used outside terms of agreement"
6230 RETURN
6240 '===========================MAIN MENU================================
6250 CLS
6260 LOCATE 2,13:PRINT "**********************************************"
6270 LOCATE 3,13:PRINT "*  MODULE I. DISTILLED BEVERAGE MANAGEMENT  *"
6280 LOCATE 4,13:PRINT "**********************************************"
```

```
6290 LOCATE 5,13:PRINT "*                    MAIN MENU                    *"
6300 LOCATE 6,13:PRINT "************************************************"
6310 LOCATE 8,18:PRINT "F1 - ENTER LIQUOR SHIPMENTS TO INVENTORY"
6320 LOCATE 10,18:PRINT "F2 - CHANGE LIQUOR COSTS"
6330 LOCATE 12,18:PRINT "F3 - CHANGE DRINK CATEGORY PRICES"
6340 LOCATE 14,18:PRINT "F4 - ENTER DAILY LIQUOR USAGE"
6350 LOCATE 16,18:PRINT "F5 - PREPARE LIQUOR ORDER REPORT"
6360 LOCATE 18,18:PRINT "F6 - VIEW COST ANALYSIS"
6370 LOCATE 20,18:PRINT "F7 - EXIT SYSTEM"
6380 LOCATE 23,8:COLOR 0,7:PRINT "PRESS [F10] [RETURN] AT ANY TIME TO GET BACK TO MAIN
MENU":COLOR 7,0:
6390 RETURN
7000 '=============================CHANGE DRINK PRICES=========================
7001 PRINT #3,TIME$,3
7009 CLS
7015 FOR X=1 TO 4:NEWPR(X)=DRPR(X):NEXT X
7020 LOCATE 2,18:COLOR 0,7:PRINT "     DRINK CATEGORY PRICES      ":COLOR 7,0
7030 LOCATE 5,18:PRINT "1. WELL DRINKS";
7040 LOCATE 7,18:PRINT "2. CALL BRAND DRINKS";
7050 LOCATE 9,18:PRINT "3. PREMIUM BRAND DRINKS";
7060 LOCATE 11,18:PRINT "4. SPECIAL BRAND DRINKS";
7070 LOCATE 5,44:PRINT USING "$##.##";DRPR(1)
7080 LOCATE 7,44:PRINT USING "$##.##";DRPR(2)
7090 LOCATE 9,44:PRINT USING "$##.##";DRPR(3)
7100 LOCATE 11,44:PRINT USING "$##.##";DRPR(4)
7110 LOCATE 22,2:PRINT "WHICH ITEM DO YOU WISH TO CHANGE (1-4)? ";
7120 LINE INPUT;X$
7130 IF X$="" THEN 8000
7140 X=VAL(X$)
7250 IF X<1 OR X>4 THEN 7300
7260 LOCATE 22,55:PRINT "NEW PRICE? ";
7270 LINE INPUT;PRC$(X)
7280 NEWPR(X)=VAL(PRC$(X))
7290 IF X=1 THEN R=5
7291 IF X=2 THEN R=7
7292 IF X=3 THEN R=9
7293 IF X=4 THEN R=11
7294 LOCATE R,44:PRINT USING "$##.##";NEWPR(X)
7300 LOCATE 22,2:PRINT SPC(75);:GOTO 7110
8000 LOCATE 22,2:PRINT SPC(75);
8010 LOCATE 22,2:PRINT "DO YOU WANT TO SAVE OR IGNORE CHANGES (S OR I)? ";
8020 R$=INPUT$(1)
8030 IF R$="S" OR R$="s" THEN 8050
8040 IF R$="I" OR R$="i" THEN 8100
8045 GOTO 8000
8050 FOR X=1 TO 4
8060 IF NEWPR(X)>0 THEN DRPR(X)=NEWPR(X)
8070 NEXT X
8100 RETURN 1040
9000 '===================================ERROR TRAPPING======================
9001 PRINT #3,TIME$,10
9010 CLS
9020 RETURN 1040
9280 '=======DAILY USAGE ===========DISPLAY INVENTORY=======================
```

```
9281 PRINT #3,TIME$,4
9290 CLS
9300 LOCATE 2,1:COLOR 0,7:PRINT "ITM CATEGORY   BRAND                                  ":COLOR 7,0:
9310 LOCATE 2,41:COLOR 0,7:PRINT "ITM CATEGORY   BRAND                                  ":COLOR 7,0:
9320 FOR X=1 TO 20
9330 LOCATE X+2,1:PRINT USING "##. ";ITM(X);
9340 LOCATE X+2,5:PRINT CAT$(X);
9350 LOCATE X+2,16:PRINT NAM$(X);
9360 LOCATE X+2,41:PRINT USING "##. ";ITM(X+20);
9370 LOCATE X+2,45:PRINT CAT$(X+20);
9380 LOCATE X+2,56:PRINT NAM$(X+20);
9390 NEXT X
9400 '==========================ENTER INVENTORY AMOUNTS======================
9420 LOCATE 2,33:COLOR 0,7:PRINT " USED  ";:COLOR 7,0
9430 LOCATE 2,73:COLOR 0,7:PRINT " USED  ";:COLOR 7,0
9440 LOCATE 24,1:PRINT   "WHICH ITEM TO RECORD USAGE (1-40)? ";
9450 LINE INPUT;X$
9460 IF X$="" THEN 9570
9470 X=VAL(X$)
9480 IF X<1 OR X>40 THEN 9560
9490 LOCATE 24,45:PRINT;"LITERS USED (IN TENTHS)? ";
9500 LINE INPUT;R$
9510 IF R$="" THEN 9560
9520 SUBINV(X)=VAL(R$)
9530 IF SUBINV(X)<0 THEN 9560
9532 IF SUBINV(X)<=INV(X) THEN 9540
9534 LOCATE 24,45:PRINT "ERROR - USAGE EXCEEDS INVENTORY";
9536 BEEP:FOR Q=1 TO 999:NEXT Q:LOCATE 24,45:PRINT SPC(31):GOTO 9490 9540 IF X<21 THEN LOCATE
X+2,33:PRINT USING "##.#";SUBINV(X);
9550 IF X>20 THEN LOCATE X-18,73:PRINT USING "##.#";SUBINV(X);
9560 LOCATE 24,2:PRINT SPC(75);:GOTO 9440
9570 LOCATE 24,1:PRINT SPC(75);
9580 LOCATE 24,5:PRINT "DO YOU WANT TO SAVE OR IGNORE CHANGES (S OR I)? ";
9590 R$=INPUT$(1)
9600 IF R$="I" OR R$="i" THEN 9650
9610 IF R$="S" OR R$="s" THEN 9630
9620 GOTO 5570
9630 FOR X=1 TO 40:INV(X)=INV(X)-SUBINV(X):NEXT X
9650 CLS:RETURN 1040
9738 GOTO 9490
10000 '=========================END==================================== 10001 PRINT
#3,TIME$,7
10010 CLS
10020 LOCATE 12,20:PRINT "ARE YOU SURE YOU WANT TO QUIT (Y OR N)? "; 10030 X$=INPUT$(1)
10040 IF X$="Y" OR X$="y" THEN 10090
10050 RETURN 1040
10090 OPEN "B:INVEN.DAT" FOR OUTPUT AS #1
10100 FOR X=1 TO 40
10110 PRINT #1, X,PRC(X),INV(X),ADDINV(X),SUBINV(X),NEWPRC(X)
10120 NEXT X
10130 FOR X=1 TO 4
10140 PRINT #1,DRPR(X)
10150 NEXT X
10160 CLOSE #1
```

```
10161 PRINT #3,TIME$,9
10162 CLOSE #3
10170 SYSTEM
12000 '=========================PREPARE LIQUOR ORDER========================
12001 PRINT #3,TIME$,5
12010 CLS
12014 LOCATE 1,1:COLOR 0,7
12015 PRINT "CODE  CATEGORY    BRAND NAME        IN INV   PAR   DIFF  ORDER BOTTLE    "
12016 COLOR 7,0
12019 PRINT "                                    Liters Liters Liters Units"
12020 FOR X=1 TO 20
12030 GOSUB 12090
12040 NEXT X
12045 LOCATE 24,18:PRINT "HIT ANY KEY TO CONTINUE";:R$=INPUT$(1)
12050 CLS
12051 LOCATE 1,1:COLOR 0,7
12052 PRINT "CODE  CATEGORY    BRAND NAME        IN INV   PAR   DIFF  ORDER BOTTLE    "
12053 COLOR 7,0
12054 PRINT "                                    Liters Liters Liters Units"
12060 FOR X=21 TO 40
12070 GOSUB 12090
12080 NEXT X
12081 LOCATE 24,16:PRINT "HIT ANY KEY TO RETURN TO MAIN MENU";:R$=INPUT$(1)
12082 RETURN 1040
12090 IF X<21 THEN C=X ELSE C=X-20
12091 LOCATE C+2,1:PRINT USING "####";COD(X);
12100 LOCATE C+2,7:PRINT CAT$(X);
12110 LOCATE C+2,19:PRINT NAM$(X);
12120 LOCATE C+2,38:PRINT USING "##.#";INV(X);
12130 LOCATE C+2,46:PRINT USING "##";PAR(X);
12140 LOCATE C+2,52:PRINT USING "##.#- ";INV(X)-PAR(X);
12150 IF INV(X)=>PAR(X) THEN 12200
12160 ORDER=CINT((PAR(X)-INV(X))/SIZ(X))
12170 LOCATE C+2,59:PRINT USING "##";ORDER;
12180 LOCATE C+2,63:PRINT USING " #.##";SIZ(X);:PRINT "L";
12200 RETURN
13000 '========================COST REPORT===================================
13001 PRINT #3,TIME$,6
13010 CLS
13011 LOCATE 2,20:PRINT "Daily Revenue and Cost Report"
13012 LOCATE 3,20:PRINT "(System set for 1 ounce pour)"
13020 LOCATE 7,1:PRINT "Well Drinks";
13030 LOCATE 9,1:PRINT "Call Drinks";
13040 LOCATE 11,1:PRINT "Premium Drinks";
13050 LOCATE 13,1:PRINT "Special Drinks";
13060 LOCATE 16,1:PRINT "TOTALS"
13070 FOR X=1 TO 40
13080 IF TYP$(X)="W" THEN 14000
13090 IF TYP$(X)="C" THEN 14100
13100 IF TYP$(X)="P" THEN 14200
13101 IF TYP$(X)="S" THEN 13110
13102 GOTO 15000
13110 SUSE=SUSE+SUBINV(X)
13120 SCOST=SCOST+((PRC(X)/SIZ(X))*SUBINV(X))
```

```
13130 GOTO 15000
14000 WUSE=WUSE+SUBINV(X)
14010 WCOST=WCOST+((PRC(X)/SIZ(X))*SUBINV(X))
14020 GOTO 15000
14100 CUSE=CUSE+SUBINV(X)
14110 CCOST=CCOST+((PRC(X)/SIZ(X))*SUBINV(X))
14120 GOTO 15000
14200 PCOST=PCOST+((PRC(X)/SIZ(X))*SUBINV(X))
14219 PUSE=PUSE+SUBINV(X)
15000 NEXT X
15101 WREV=WUSE*33.8*DRPR(1)
15102 CREV=CUSE*33.8*DRPR(2)
15103 PREV=PUSE*33.8*DRPR(3)
15104 SREV=SUSE*33.8*DRPR(4)
15200 LOCATE 5,25:PRINT "Revenue"
15210 LOCATE 5,40:PRINT "  Cost"
15220 LOCATE 5,50:PRINT "Cost Percent"
16000 LOCATE 7,20:PRINT USING "########.##";WREV
16010 LOCATE 9,20:PRINT USING "########.##";CREV
16020 LOCATE 11,20:PRINT USING "########.##";PREV
16030 LOCATE 13,20:PRINT USING "########.##";SREV
16040 LOCATE 7,35:PRINT USING "########.##";WCOST
16050 LOCATE 9,35:PRINT USING "########.##";CCOST
16060 LOCATE 11,35:PRINT USING "########.##";PCOST
16070 LOCATE 13,35:PRINT USING "########.##";SCOST
16075 IF WREV=0 THEN 16085
16080 LOCATE 7,50:PRINT USING "##.##";WCOST/WREV
16085 IF CREV=0 THEN 16095
16090 LOCATE 9,50:PRINT USING "##.##";CCOST/CREV
16095 IF PREV=0 THEN 16105
16100 LOCATE 11,50:PRINT USING "##.##";PCOST/PREV
16105 IF SREV=0 THEN 16120
16110 LOCATE 13,50:PRINT USING "##.##";SCOST/SREV
16120 LOCATE 16,20:PRINT USING "########.##";WREV+CREV+PREV+SREV
16130 LOCATE 16,35:PRINT USING "########.##";WCOST+CCOST+PCOST+SCOST 16135 IF
WREV+CREV+PREV+SREV=0 THEN 16150
16140 LOCATE 16,50:PRINT USING "##.##";(WCOST+CCOST+PCOST+SCOST)/(WREV+CREV+PREV+SREV)
16150 LOCATE 24,20:PRINT "HIT ANY KEY TO RETURN TO MAIN MENU";:R$=INPUT$(1)
16170 RETURN 1040
```